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INSTRUCTION OF MEDICAL STUDENTS AND HOSPITAL INTERNES IN ANESTHESIA.*

WILLIS DREW GATCH, M. D., F. A. C. S.
Professor of Surgery, University of Indiana Medical Department.
INDIANAPOLIS, INDIANA

Members of the American Association of Anesthetists:—Permit me to express to you my appreciation of the honor you have conferred upon me in electing me your president.

I have selected a subject for my address today which has a bearing upon the position of the professional anesthetist as a specialist and upon the claims of anesthesia to a somewhat important place in the curricula of our medical schools. I fear that in our interest in the purely technical part of anesthesia we are liable to lose sight of the broad general relations of the same to other branches of medical practice and to neglect opportunities to improve the professional position of the specialty. It is to present certain plans and ideas bearing on these matters that I have written this address.

Any art must suffer if it lacks an intelligent and appreciative clientele. By the extent to which anesthesia as a specialty fails to command the support of the medical profession is to be measured the failure of the latter to appreciate the advantages of good anesthesia. Nothing can do more to improve your standing as specialists than to educate physicians generally in this subject, and the best place to begin this course of instruction is with the medical student.

Unless our leading medical schools give instruction in anesthesia not described in their catalogues, the training of students in this subject must be either entirely lacking or very inadequate. Such personal inquiries as I have been able to make of medical teachers convinces me that this is the case.

I am convinced that in most of our medical schools the student receives practically no instruction in anesthesia and that the instruction therein of internes in our hospitals is usually haphazard and frequently resented by its recipients. . Though this indictment may seem severe I believe that it is warranted and that it will be sustained by an investigation of the facts. Such an investigation by this society would be worth while since, by the power of publicity, it might be productive of considerable good. Certainly so essential an art as anesthesia is worthy of more consideration by those who plan our courses of medical instruction, but any one suggesting that more attention be given it would be immediately confronted by many apparently valid objections, of which the most weighty are the following:—

(1) That the medical curriculum is already crowded; (2) that only a few students will ever actually need to know much about the subject, and that these can acquire the necessary knowledge outside the regular course; (3) that most students now take an internship, where they receive ample practice in anesthesia.

Let us consider these in order: (1) It is true that the medical curriculum is at present crowded to the limit and beyond of the student's ability, but this is not because the amount of knowledge necessary for the equipment of a competent practitioner is so prodigious, but because in most cases the curriculum is poorly devised. There is poor corelation of subjects, needless duplication, undue emphasis placed upon unimportant matters, and finally too little provision made for directing the student's private study. To take the example in which we are directly interested, how can adequate instruction in anesthesia be given? The first step is to determine what the student should know about anesthesia. I believe the following ennumeration will strike you as a fair one. He should know, *first,* the physical properties and physiological action of the common anesthetic agents. *Second,* he should be thoroughly familiar with the anatomy and physiology of the organs of circulation and respiration and with the pathological conditions of these organs. *Third,* he should know the effects of hemorrhage, asphyxia, and bodily posture, and the means of curtailing them. *Fourth,* he should know enough about physical diagnosis to enable him to recognize diseases, especially of the heart and lungs, which may make anesthesia dangerous. *Fifth,* he should know as much as possible about the actual conduct of anesthesia.

This array of knowledge looks imposing enough, but you will see that everything named as essential, except the last, has been already learned by the student in his courses in pharmacology, physiology, pathology and internal medicine. All that is necessary to give a satisfactory course in anesthesia is to review these topics briefly, pointing out their relations to practical anesthesia. In meeting the last requirement, my own practice is to have each student conduct from ten to fifteen anesthetics under the direction of a trained Anesthetist, at the Hospital connected with our School. This practice is interesting for the Specialist, is of

*President's Address, Fourth Annual Meeting of the American Association of Anesthetists, Detroit, Mich., June 12, 1916.

no harm to the patient, in no way bothers the operator, and certainly benefits the student.

At this point I wish to digress for a moment to state my opinion that the better part of surgery is after all physiology. I have found that many facts, the understanding of which is vital to any real knowledge of surgery, can be most simply presented by a course in surgical physiology. Likewise the better part of anesthesia is physiology and for this reason I believe that some affiliation of this Society with the Section of Physiology and Pathology of the American Medical Association would be highly beneficial to the progress of anesthesia.

Now for the second objection given above, that not all students require a knowledge of anesthesia:—This is not true. Though the student when graduated, may never himself administer an anesthetic, he will most certainly have patients who will require one, and he cannot properly safeguard their interests if ignorant of the subject. The third objection, that nearly all students after being graduated take an internship in the course of which they acquire a sufficient knowledge of anesthesia, calls for a careful examination. If all students were to take hospital internships, and if the same were in hospitals where the giving of anesthetics is carefully supervised by trained anesthetists, then this objection to the teaching of anesthesia in the Medical School would be partially valid, but I scarcely need to remind you that not all students take internships, and that in comparatively few institutions is there adequate expert supervision of the anesthesia. This leads us to consider just what this supervision should be. I have myself tried out the plan herewith proposed, and have found it a most satisfactory one. It involves the conception that the duties of the anesthetist should not be limited to the actual conduct of the anesthesia, but should cover also the preliminary examination and preparation of the patient and his immediate post operative care..

From a study of deaths or other calamities of anesthesia I am convinced that some system as I have mentioned is far more important than the adoption of any particular form of anesthesia. The plan is as follows: A trained anesthetist is put in charge of the entire matter. It is his duty to see that every patient is properly examined and prepared before operation. The examination includes careful inspection of the nose and throat, careful examination of the heart, lungs and arteries, and at least one urinanlysis. Also the sizing up of the patient generally as an operative risk. After this study the anesthetist advises the operator as to the best form of anesthesia to employ or as to the advisability of giving an anesthetic at all.

Under the supervision of the trained anesthetist are the internes, who each have a definite term of service in this work. They actually make the examinations described and also, under the trained man's direction administer the anesthetic in all ordinary cases. During the operation surgeon and anesthetist work together, so as to spare the patient as much as possible. During and after the operation the anesthetist has charge of the general care of the patient,—the administration of salt solution, external heat, etc. In case of any post-operative complications, as prolonged nausea, pneumonia, or paralysis, the interne anesthetist must make an investigation and report the same in full to the chief anesthetist and to the surgeon. The record of the anesthesia is kept on the same sheet on which are the operative notes.

The advantages of this plan I have found to be many:

(1) It insures adequate examination and preparation for every patient and thus does much to minimize the risks of operation. The dangers are foreseen and for the most part prevented.

(2) It emphasizes the relations of anesthesia to other branches of medicine.

(3) It insures every interne a broad and practical training in anesthesia.

(4) It makes the position of the trained anesthetist one of importance and dignity and gives him the opportunity and encouragement to work for the advancement of his art.

Many of you hold teaching positions in Medical Schools, and nearly all of you have important hospital connections. I therefore hope that the foregoing discussion may have been of interest to you and close with the plea that individually and as a Society you make every effort to secure more adequate instruction in your important, specially to medical students and internes.

HUME-MANSUR BLDG.

SPECIAL EDITORIAL COMMENT.

As a result of the President's address, during the executive session following the Association dinner, a committee composed of Drs. Isabella C. Herb, Walter M. Boothby and F. W. Nagle, was appointed to investigate the teaching of anesthesia in medical schools, and to report on some plan for advancing such teaching and also in establishing some uniform method of training internes in the hospital anesthetic service. At the second annual meeting of the Interstate Association of Anesthetists in Louisville, July 26, this movement was unanimously endorsed and the Association voted to co-operate individually and collectively with the committee of the American Association.

The Program committees for future meetings will also follow Dr. Gatch's suggestion in developing the physiopathological aspects of anesthesia.—Editor.

TEAM-WORK.*

CHARLES W. MOOTS, M.D.,
TOLEDO, OHIO.

By way of encouragement to your patience, let me advise you at the outset that this paper will not discuss in detail many things that migth be taken up under such a broad subject. The title was rather hurriedly chosen as an excuse under which I might offer to this timely association some practical deductions relative to the important question of anesthesia as viewed from the surgeon's standpoint.

The very first point that I wish to impress upon the members present is this, that the deductions I have to offer are the result of a considerable number of years of careful personal experimentation and study, and that I have no fetich or dogma to support. I am hoping that this experience will prevent me from making many of the foolish statements that I have noticed in our Journals the past few years. For example, I have read articles written by very prominent surgeons in which were found the following conclusions: "Nitrous oxid-oxygen anesthesia should be limited to very short cases"; or "It should be used only in minor surgery"; or "That it cannot be used in major surgery"; or it is "Good for hazardous risks." Five years ago these statements irritated me; today they simply cause me to feel sorry that men whose word carries such great influence will flash before our great profession such false statements relative to such an important subject.

THE PROFESSIONAL ANESTHETIST.

In my judgment, the most important conclusion I have ever reached, especially to my patients, was this, that professional anesthesia is a positive necessity. There are probably others present who will remember the days when the patient was accompanied by their friend and usual medical attendant in order that the anesthetic might be safely administered. The probabilities were that the doctor had given about three or four anesthetics in as many years. This sort of service certainly did not spell *efficiency* or *safety*.

It was about ten years ago that I arranged for the services of Dr. McKesson as anesthetist. The subject was still in its infancy compared to the present time, and the rest of my remarks will simply be a brief recital of our combined efforts during these years.

ETHER AND ITS DISADVANTAGES.

We relied at first almost entirely upon ether as a general anesthetic, as that agent practically settled the question of immediate mortality. There were certain things occurring, however, which we felt should be prevented. We spent much time together in an endeavor to prevent these things. The awful nausea, sometimes lasting for days, seemed unnecessary; the functions of many organs were interfered with, as proven by laboratory findings; delayed deaths occurred, the cause of which we could not conscientiously attribute to the surgical traumatism alone. The symptoms shown in many of these cases are now grouped under the term *acidosis*. We are thoroughly convinced that if many of the cases did not die *of* acidosis, they at least died *with* acidosis, and that one of the etiological factors was the anesthetic. At any rate, since routinely using gas anesthesia and preliminary alkaline treatment, we escape our former mortality and morbidity rate. The remembrance of the nausea and its attending evils often remained for months, causing a bad psychological condition, which grew worse at each and every rehearsal to some new friend or neighbor. All sorts of aids and adjuncts were invoked to prevent these things. These agents included pre- and post-operative remedies and procedures. Improvement in results was not marked.

EARLY EXPERIENCES WITH N_2O-O.

In 1907 we became interested in nitrous oxid-oxygen in a small way. At first our difficulties were many, ignorance of the necessity of joint study and cooperation, poorly devised equipment for administration, and a lack of experience in the signs of this form of anesthesia, being the causes in the light of my present knowledge.

It is true that for two or three years we had some of the troubles commonly attributed to gas anesthesia, but we felt that as the apparatus was improved and our experience broadened, these difficulties could be overcome, and we could offer our patients some decided advantages. Our great difficulty was, of course, due to less relaxation than we had secured under ether, and the necessity of adding ether to the gases too frequently. This problem was not solved in a month, or even a year; but we kept at it, instead of condemning the principle. Today we are happy in the conscious enjoyment of a technic which leaves little to be desired. We have received much aid and encouragement from other clinics, especially from that of our neighbor, Dr. Crile.

In working out the problem of operating any patient without the slightest perceptible shock, and returning them to their usual occupation in the briefest possible period of time, which proposition

*Read during the Fourth Annual Meeting of the American Association of Anesthetists, Detroit, June 12, 1916.

I believe should be our ideal, we marshal our forces to the attack under three periods.

PRE-OPERATIVE, OPERATIVE AND POST-OPERATIVE PERIODS.

The first period comprises the time extending from the first consultation of the surgeon up to the operating period. This period should start out with a pleasant, yet most careful study of the individual. A positive diagnosis should be made wherever possible, as this not only gives the patient needed confidence, but permits the operation to be completed in the briefest possible time. When nothing exists to contraindicate, the operation should be done without any delay, after a decision is once reached that an operative procedure is the one of choice. This minimizes many adverse stimuli coming from well-meaning but ignorant friends. Officials and nurses about the hospital, all are included in the forces which are brought into play to cure the patient, and therefore must understand the importance of proper psychical suggestions. Great thought and care must be given to each individual case, that we may be sure not to view the patients as mechanical devices only, or write orders simply for number so and so.

Preliminary preparation of the patient is of the simplest nature. The body is kept full of fluids, usually alkaline. Complete rest during the night preceding the operation is secured by whatever sedative is considered best for the individual case, which we find generally to be the simplest, namely, sodium bromid. We practically always use some preliminary narcotic, the drug and dosage being considered in each case. If there are no contraindications, we prefer to start two hours before the operation with an hypodermic injection of some form of opium with scopolamin; this is repeated an hour later. All visitors, including relatives, are excluded from the patient during these two hours. By these means the patient reaches the operating room practically asleep, at least with absolutely no fear, and therefore with an exceedingly high threshold to external as well as internal stimuli.

The second period, which consists of the operation itself, is now started. This period should be completed in the briefest possible space of time compatible with the best work.

One of the great advantages of gas is the fact that if the patient comes to operation with the preparation as described, there is not one unpleasant manifestation while being anesthetized. The majority of our patients are unconscious within thirty seconds after starting them. The field of operation is now blocked off with novocain. There are a few important points I have finally learned that anyone must master before he can enjoy this anesthesia. Among them are these: Don't begin to operate until your anesthetist tells you to. Master the velvet, steady touch, and always with wet gloves when within the abdomen. Anyone who learns to operate easily with gas has acquired a technic that causes much less traumatism than one who cannot so operate. Avoid the use of the extreme Trendelenberg position. Be ready to stop manipulations at any time your anesthetist asks you to—it will probably be for only ten seconds; this really saves time, for he can thereby secure the relaxation you desire, and with much less traumatism than if you continue pulling at the muscles. *Sudden movements of the hands in the abdomen or sudden stretching of the incision causes resistance. Back in our studies of the physiology of the muscle-nerve preparation we observed that the excised frog muscle contracted if stimulated by sudden stretching. The abdominal wall about the incision can ordinarily be lifted three inches above the intestines, so long as the lift is steady, but as soon as the incision is suddenly jerked by the surgeon or assistant, resistance begins and is intensified with each subsequent effort to forcefully overcome the resistance by sudden movements.*

Absorbable suture are used throughout, and we believe it most important to use the smallest size that will withstand the necessary strain, and the kind that will be absorbed just as soon as their function is completed. This factor is especially important in deciding the period of morbidity.

In many cases, and especially of Basedow's goiter, we block off the operated field before leaving, with quinin and urea hydrochlorid.

During the past two years we have added no ether, except upon two occasions, and for the past year not one drop. In fact, we are now using a machine in which there is no provision made at all for any ether.

During these years we have operated with full knowledge of blood pressures in nearly all of the cases. Our experience leads us to the conclusion that nothing very serious happens to a patient on the table without showing circulatory changes. It is considered a part of the anesthetist's duty to keep the surgeon informed of any unsatisfactory change, which is frequently so insiduous in its development that only the sphygmomanometer may detect it with enough accuracy to permit of comparison every few minutes. The systolic pressure is not enough to know; we must have diastolic and pulse-pressure along with pulse-rate and respiratory rate, and volume. The character of the respi-

rations we believe to be of great importance, especially in the very bad risks.

Looking forward to a brief convalescence, we permit no lay friends or relative to be present during the operative period. None of the procedures are therefore rehearsed to the patient. The staff of Flower Hospital recently unanimously voted in favor of a resolution prohibiting the presence of laymen in any part of the surgical department. This is mentioned only in the hope that other hospitals may be inspired to take the advanced step.

We now come to the third or last period, which is so placed on account of sequence and not because it is of least importance. On the contrary, many of the battles are won and lost during this period. The opportunities to secure the desired psychical conditions are greatly increased during this period. However, if the details above described are closely followed, the work during the third period will not be so arduous. There is one fact that stands out prominently, and should be heeded by all surgeons, and this is that no patient is well until she thinks she is well. When one catches this viewpoint, he will be a factor in preventing a large number of chronic incompetents.

The physical after treatment should be of the simplest kind. We give freely of water immediately after the operation. Positions which give the greatest relaxation of muscles about the operated field should be procured unless especially contraindicated. To cure the emotional disturbances, minimize the character of the operation and constantly maintain an extreme optimism. Avoid all bandages and unnecessary appliances in the usual case. Get the patient out of bed early. We get our interval appendectomies out of bed the following day, and permit them to walk about on the third day.

There are many little details that we have omitted, fearing that a recital of complete methods might become tiresome, and can only hope that a general discussion will elicit points that will be of mutual interest. However, before closing I wish to offer these few conclusions that Dr. McKesson and myself feel are now proven and may be used with benefit.

First, nitrous oxid-oxygen as an anesthetic, while extremely dangerous in unskilled hands, is by far the safest anesthetic in skilled hands.

Second. It produces anesthesia without appreciably injuring any cells in the body.

Third. It may be successfully used in all abdominal surgery, and is especially indicated in cases requiring great length of time.

Fourth. The preliminary treatment is of the utmost importance, and should never consist of any atropin, nitrous-oxid itself being a powerful respiratory stimulant.

Fifth. It favors the production of the very best psychical condition of the patient, and therefore predisposes to a higher percentage of permanent cures with shorter periods of morbidity.

Sixth. It favors the growth of professional anesthesia, which is greatly to be desired.

Seventh. While the degree of M. D. carries with it the legal right to administer anesthetics, there is a moral responsibility which requires special training for this work.

Eighth. The surgeon must realize constantly that he is dealing with a living organism and not a mere mechanical device, and that rough traumatic attack will surely be followed by resistance of some sort.

ABSTRACT OF DISCUSSION.

DR. WALTER M. BOOTHBY, Boston: Dr. Moots, in this paper, mentions the postoperative treatment. I wish to say a word regarding this and pneumonia. We have a wide-open pavilion at our hospital. The recovery room was at one time quite cold and draughty, and they had a series of four or five pneumonias following operations. We had had some cases of this kind before that, but I had not had any in my personal cases. The staff attributed this to the kind of anesthesia that I was giving, but it was not due to that at all. It was due to the exposure of patients after the operation that they got pneumonia. Although the nursing was good, it was not good enough. Since then, by keeping the recovery room warm and being sure that the patients were well covered up before being taken back to the wards, we have succeeded in improving matters so that we have had only one case of ether pneumonia this year. In that case, the postoperative treatment was turned over to a nurse whose sole duty it was to see that this was taken care of by the junior nurses; but in this case, the junior house officer, contrary to this nurse's directions, opened the window. I merely mention that to bring out the fact that postoperative care in preventing the patients from getting exposed to draughts will greatly reduce the number of cases of ether pneumonia.

DR. HERBERT: I wish to congratulate Dr. Moots particularly on the point which I thought he would have brought out more strongly, of team work. I have often wished that our surgeons and hospital workers could attend this meeting and listen to the talk of the anesthetists more than they do. I feel that a great deal of our work is wasted, because the men from whom we look for good results do not hear it. Some, of course, read it in the magazines afterwards; but many do not. The importance of the surgeon's help strikes me as of the very greatest moment in methods of anesthesia, and the opinions of different surgeons are bound to be at variance. The agent used is of great importance; and there, again, I think that the surgeons do not help us as much as they might in consulting us about the choice of an anesthetic and the management of the patient before and after, as well as during the operation. It would seem to me that very much too often the anesthetist is considered a necessary part of the operation, and not thought of before or afterwards. How often the anesthetist is blamed for bad results he only knows himself. If I could add anything at all to stimulate our surgeons and hospital workers to assist in this team work, I should like to do so. To that end, I would suggest that if Dr. Moots' views could be spread broadcast in the surgical world, it would do far more good for advancing surgery than all our discussions of scientific anesthesia.

DR. C. C. MCLEAN, Dayton, O.: I want to add a

word of thanks for this excellent paper. With regard to what the gentleman has just said, I was thinking that if this paper had been presented to the surgeons, instead of the anesthetists, we probably would have reaped a greater reward. In giving nitrous oxid as an anesthetic, it is disgusting to have the operator paw around in the intestines as though he were a dog digging; and yet that is what we have to contend with, and then the surgeons will condemn the best method of anesthesia known to the world today. I feel, therefore, that this message of Dr. Moots should be carried to the surgeons in some way or other.

DR. G. W. KENNEDY, Sharon, Pa.: I should like to add my voice to the sentiments expressed by Dr. Moots. The time is not so long since the anesthetist bore the same importance to the surgeon that the printer's devil bears to the editor of a paper. He was more or less of a necessity for the time being. We find now, however, that people are now asking, "Who is going to anesthetize me?" as well as "Who is going to operate on me?" I was particularly struck with this paper in regard to team work. I have been trying to secure team work in our own town. I think that this paper should be brought to the attention of the surgeons who are operating. We should get it into the hands of as many surgeons as possible.

DR. A. M. CAINE, New Orleans: I should like to know what percentage of vomiting there was in the cases of Dr. Moots.

DR. MOOTS (closing): I should like to assure you all that I am carrying the *"message to Garcia"* as fast as I can, in all the societies that I am a member of.

In regard to what Dr. Kennedy said, I think that the question is how to reach the surgeon. It is certainly discouraging. In connection with nitrous oxid gas, the surgeons are still talking of the things I have mentioned to you. It is aggravating; and the only thing you can say is that it is better not to know so much than to know so much that is not so. I believe that the men who have had a broad training are going to get into the spirit of not having a method that they are going to defend, but that they will be open to suggestions coming from meetings like this.

In reply to Dr. Caine with regard to vomiting, our cases during the last year ran less than four per cent.; and of that percentage, the majority had but slight vomiting on the table, and none afterwards at all. In fact, it is a peculiar thing that the patient who has a little vomiting immediately after the cessation of the operation is not nauseated again.

ETHER-OIL COLONIC ANESTHESIA.*

WALTER LATHROP, M. D.
HAZLETON, PENNSYLVANIA.

In presenting this subject before an assemblage composed largely of expert anesthestists, there is no attempt made to hand out material that is not familiar to a good many present, but the main idea is to place before you our experience from the standpoint of the operator, with this method of inducing anesthesia.

Dr. James T. Gwathmey, of New York City, must be given full credit in bringing forward this procedure, and to his patiently working out various methods, and discarding combinations that were not proper, we owe today whatever there may be of value in it. Cunningham of Boston first used air as a means of conveying ether vapor into the intestinal tract, and the work of Sutton and Cunningham was of help to the originator of the present scheme of ether-oil.

*Read during the Fourth Annual Meeting of the American Association of Anesthetists, Detroit, June 12, 1916. From the Surgical Department of the State Hospital, Hazelton, Pa.

PHYSIOLOGICAL EFFECT.

Soon after the first administration of the mixture, the psysiological effects are shown, when it becomes warmed to bodily temperature, and at this point the ether becomes gas (or some of it does), and is rapidly absorbed by the capillaries of the colon, and carried to the general circulation, is taken through the lungs, where some is excreted, and some reabsorbed, and carried to the brain. In our experience there has been little or no change in blood pressure. The brain does not seem to be deeply narcotized as in the inhalation method, and the patient usually regains consciousness rapidly, after the bowel is washed out, as will be mentioned later.

The eye reflex is seldom lost, while relaxation of the general muscular system is usually complete. The four factors acting in harmony which help to maintain an even anesthesia are the following:—

1. The constant rate of evaporation of the ether from the oil.
2. The distention of the colon, causing less ether to be absorbed than when partially distended.
3. As the ether leaves the oil, both mixture and gut are cooled, and this retards elimination and absorption.
4. The difference between the absorptive power of the colon and the eliminative capacity of the lungs. (Gwathmey.)

INDICATIONS AND COMPLICATIONS.

Where fear is a prominent element as in goitre operations, and especially the toxic cases; in neurotics; in patients with asthma, particularly those cases we see so often in miners, where the breathing is very difficult, ether-oil is the method of choice. I have seen these individuals sleep calmly under colonic anesthesia, with none of the cyanosis, and choking in the inhalation method. It is useful in those patients who have short, thick necks, and narrow air passages, and it is valuable in all operations upon the head and neck. It is *contra-indicated* in *rectal disease of any kind,* or when *pain* is *caused by its introduction.* We have had but one case of looseness of the bowels following this method.

In our experience the postoperative effects have been excellent, in fact better than with the routine methods of ether or chloroform, and vomiting has been much less frequent than after inhalation. The patient on awakening is usually comfortable, aside from the throat irritation often following thyroidectomy. They can retain nourishment, or medication in most instances, while after abdominal opera-

tions there is much less pain for some time, even though consciousness has been regained.

TECHNIC.

In our own work, the method of administration, as followed now, after various experiments, consists first of administering a laxative the night before operation, followed by an enema of suds the next morning. The lower bowel should be empty; a special rectal tube one-quarter inch in diameter with eye in the side should be used, and a clamp for the tube should be provided, also a small funnel into which the mixture is poured. Gwathmey has designed a special tube for this work. Children under twelve years need no preliminary treatment aside from the enema. The patient should be preferably in the Sims position.

The mixture used by us for the preliminary injection consists of:—

Paraldehyde, two to four drams,
Ether, one-half ounce,
Olive Oil, one-half ounce.

This is slowly injected into the rectum, forty minutes before the time set for operation. Twenty-five minutes after this mixture is given, a quarter grain of morphia is administered *hypodermically*. After forty minutes from the first injection, or more if necessary, the final mixture, consisting usually of:—

Ether, three ounces,
Olive Oil, two ounces,

thoroughly mixed in a bottle, is given slowly, about *one ounce per minute*, and by the time all has been introduced the patient should be asleep. Several folds of gauze should be placed over the face, and the anesthetist should watch the case as in any other method. In some instances, a damp towel over the face will deepen the anesthesia, where the gauze will lessen it. Occasionally a little ether will be needed by inhalation to induce perfect narcosis, but this is not the rule. *Experience is the great factor;* and in our earlier work we used four, and five ounces of ether-oil, where now we rarely exceed three; and in stout patients three and a half to four ounces. *It is important that the use of this mixture be in the hands of one who can begin its administration and have it under his or her care in all cases, and not be delegated to a different doctor or nurse each time it is given.*

REACTIONS UNDER ANETHESIA.

The breathing is usually quiet and regular; pulse normal and reflexes not disturbed. Should there be cyanosis, stertor or marked loss or reflex, it is an indication to withdraw one or two ounces of the mixture from the colon. The rectal tube is always left in the bowel, and clamped. Should respiratory arrest occur, of course the treatment would be the same as in any case under inhalation anesthesia, plus the emptying of the intestine. After the operation is completed, or better, while the sutures are being introduced, the rectum should be thoroughly irrigated with tap water, and gentle massage of the colon from right to left will help expel any mixture remaining. After irrigating the bowel, we inject a pint of tap water and four ounces of olive oil.

We have tried a variation of the preliminary injection, as recommended by Gwathmey. This consists of:—

Morphia, one-fourth grain,
Bromide of Potash, two drams,
Paraldehyde, two drams,
Water, q. s. ad., four ounces.

This is given one hour before operation, and followed at the regular time by the ether-oil mixture. We have not followed this as a routine, but depend altogether on the mixture and method already mentioned. The amount of ether-oil has been reduced at least one-third since this procedure. A six-ounce mixture, four of ether and two of oil, will maintain splendid anesthesia for more than an hour, or long enough for any ordinary major operation, while usually in goitre work, we rarely use more than three ounces of ether. For children, equal parts of ether-oil should be used, and as a rule two ounces will do the work.

UTILITY.

In bringing this subject before this association, I am not endeavoring to give anything new, as Dr. Gwathmey has already done much missionary work; but to emphasize my belief in its great value in special cases, and particularly *Thyroidectomy*, where freedom of movement is essential, and the ether cone an absent member. Any one who has had experience with hyperthyroid conditions, with the associated apprehension, nervous tension, and tachycardia, can appreciate the great satsifaction of being able to anesthetize patients in bed, practically without their knowledge, and complete an operation, with no added element of fear. Also its value must be admitted in those conditions where the toxic element is not yet present, but the border line is about reached. As far as calmness and indifference is concerned, the principle of anoci association is realized, while the technic of Crile can be easily carried out if desired, and is of great value in many cases. In the high strung, nervous patients it is our practice to give every day or every other day, an injection of four ounces of water, with instructions to retain it for the tonic effect. The morning of operation the patient is given the regular dose of paraldehyde etc., and later on the regular mixture,

after which the operation is performed. Some patients require the whole mixture while in bed, and others can be moved to the operating room, and the remainder of the mixture given there.

ADVANTAGES.

The apparatus is cheap, and the technic so simple that the anesthetist can give his, or her, whole time to the patient. Anesthesia is under control and the mixture can be withdrawn if needed. There is absence of mucous and saliva in nearly all cases, and the ether is less irritating to the Colonic membrane than the vapor is to that of the respiratory tract.

Gas pains are reduced to a minimum. The safety limit is extended owing to the gradual absorption of ether by the colon, and its rapid elimination from the lungs. Very soon after giving the preliminary dose, the odor of paraldehyde is noticed on the breath, showing the quick elimination of the drug. It is of interest to note that the experiments of Dr. W. H. Park of New York City showed that an ether-oil mixture of seventy-five per cent. killed the colon bacillus in one minute, thus giving another factor of safety, against possible infection. We do not advocate this method for general use, as time would not permit of this procedure, where there are a good many operations to be done, and we use ether chiefly, but do from one to four operations under colon anesthesia each week.

From an experience with several hundred goitres, under inhalation anesthesia, and nearly *two hundred under the ether-oil colonic method,* it is our firm belief that this latter is supreme over any other procedure with which we are familiar, though I am willing to concede a great deal to the perfected method of oxygen and nitrous oxid. However, as proved by Dr. Gwathmey, we have in the colonic method a margin of safety between the dosage required for surgical narcosis, and that causing toxemia,—*"after administering the ether-oil, it is impossible at any time to withdraw the oil and leave the ether, or vice versa. Every molecule of ether is bound to one of oil, and this union is broken only when vaporization occurs."*

Anesthesia, when established, is maintained automatically by the ether separating from the oil by well known physical laws, and this vaporization never varies, so it is impossible to have deep anesthesia at one time, and a light one at another, unless deepened by rebreathing, or lightened by an airway tube. (Gwathmey.)

Baskerville of the College of the City of New York by his studies and experiments in the laboratory, has shown that the evaporation of the ether is very constant, no matter whether cotton seed oil, lanolin, codliver, or olive oil is used, and he has had some interesting charts made to illustrate this work. The cases now recorded are well up toward two thousand, scattered over the whole country. We have thus far used the ether-oil method in 256 cases, of which 171 were for goitre or hyperthyroidism, and 85 were abdominal operations, such as hysterectomy, gall bladder affections, hernias, appendectomies, and bone grafting, the latter cases being very satisfactory, owing to the patient keeping much more quiet after operation, and allowing the plaster paris to set properly.

To demonstrate that we are conservative in our use of this method, I would state that in the past 22 months, we have administered anesthetics in 3,307 cases, of which 256 were by the *ether-oil method.* However, we have used it much oftener during the past 8 months, and will doubtless add largely to our statistics from now on.

CASES OPERATED UPON UNDER ETHER-OIL ANESTHESIA.

Goitres:—	
Hyperthyroidism (Two Deaths)	24
Parenchymatous	61
Colloid and Cystic	86
	171
Abdominal sections	85
Total	256

CONCLUSION.

In conclusion I would say that in our experience with the ether-oil:—

1. It is most valuable in head and neck operations.
2. It is valuable where bronchial affections would render the inhalation of ether irritating and dangerous.
3. There is little or no fear as seen in other methods.
4. There is less tax on the kidneys and the lungs.
5. Operations can be done with very little knowledge of its procedure on the part of the patient, which is valuable in certain conditions where fear and apprehension add to the danger in the case, and at the same time Criles nerve blocking can be easily carried out and give added safety to the operation.

ABSTRACT OF DISCUSSION.

DR. J. J. KING, New York City: I wish to congratulate Dr. Lathrop on the excellent results he has had in his goiter cases. I have seen him operate by this method on five or six patients, at different times, and they slept quietly and peacefully, and were perfectly anesthetized. I wish to report a case that I had last summer; a boy, seven years old, who had very large, septic tonsils and adenoids. He had been a *blue-baby* with a patent fora-

men ovale. He was sent to me for a tonsilectomy, and I found that it was necessary for his welfare that his tonsils and adenoids should be removed. I asked Dr. Gwathmey if he could give the anesthetic. The normal color of this patient at the time was a purple cherry-color. Dr. Gwathmey thought that he could with safety use ether-oil by rectum. We sent the boy to the hospital, not telling him that he was going to have an operation. An enema was given him each morning for a week before the operation; and on the morning of the operation, he received an enema of the ether-oil mixture, instead of the kind he had been having. He was thus anesthetized and was then carried to the operating room, where I removed his tonsils and adenoids; and it was done safely. The nurse, who had been with him a great deal during his life, said that his color during the operation was not very different from what it was ordinarily, especially when nervous or excited. He was still anesthetized when taken back to his room in the hospital. After recovery he told his mother that he had been asleep and had had a nose-bleed, not knowing that an operation had been performed on his throat.

Dr. C. J. Peck, New York City: I should like to endorse everything that Dr. Lathrop has said. I have had some experience in this work for two years, and have operated on a number of cases anesthetized in this way and have found the method very satisfactory. I think that Dr. Gwathmey is too modest in his attitude on this, and I shall be disappointed if he does not publish something on the subject pretty soon.

My last experience with this method of anesthesia was in a breast case in a patient who was very nervous and dreaded the anesthetic more than anything else. It was given in bed; and she went off to sleep, and did not know that she was getting an anesthetic. The operation was long and tedious, and she came out of the anesthetic without vomiting. She had no trouble, except that she felt some soreness. For a long time, we were unable to convince her that the operation had been done. If any of you have no use for this form of anesthesia in selected cases, I think that you should study the subject; because you will be convinced of its usefulness. Of course, there are contraindications for its use. In abdominal work, the presence of the dilated colon may give trouble. It will be coming into operative area. In rectal cases, the use of this method is contraindicated also. In breast cases, however, and in operations on the neck and face, it is the ideal anesthetic.

Dr. Lathrop (closing): I have very little to add, except that last week I had ten thyroidectomies for hyperthyroid conditions. These all had anoci preliminary treatment, as detailed by Dr. Crile. They knew nothing of the anesthesia or operation and woke up in bed; and made uneventful recoveries. I believe that in selected cases this method of anesthesia has a useful field. In cases of sarcoma of the jaw or cancer of the tongue, it is absolutely ideal and, in my opinion, absolutely safe. Experience is, of course, a great teacher; and after once having used it in selected cases and seen its effect, the surgeon will not only like this method, but, I think, demand it in many instances. I feel that it is due to the profession that Dr. Gwathmey should publish the accumulated experiences with this method.*

SPECIAL EDITORIAL COMMENT.

**In The American Year-Book of Anesthesia and Analgesia, recently issued by the Surgery Publishing Co., New York City, Dr. Gwathmey presents an exhaustive paper on Ether-Oil Colonic Anesthesia, detailing not only the historical and experimental evolution of the method, but also its histo-pathology, technic, utility for certain procedures and the accumulated experience of those who are using it as a routine.*

As this method of anesthesia promises to become one of the most valuable routine technics for special operative procedures, it will be invaluable for the specialist in anesthesia to base his knowledge on the experience of those who have made it a success.—Editor.

VAPOR ANESTHESIA FOR INTRAORAL SURGERY.*

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The first vapor inhaler was constructed by Junker in 1867 and was intended for the administration of chloroform vapor. This apparatus consisted of a hand bulb, bottle and delivery tube, and was almost indispensable in many operations upon the head. Hewitt states that on more than one occasion the rubber tubing has been connected wrong, and as a result liquid chloroform has squirted out through the delivery tube, and since one or two fatalities had thus arisen he had deemed it wise to modify the inhaler. Braun further modified the original Junker inhaler so chloroform or ether, or a combined vapor could be obtained, attempting to heat the vapor by passing it through hot water. Ether was fast coming to the front at the time as a safer anesthetic than chloroform. As the ether vapor came more in demand there were different types of apparatus constructed to deliver it. Gwathmey used a three bottle device, by which a moist ether or chloroform, or a combined vapor could be given. Gatch at Johns Hopkins used an apparatus in which the ether vapor was passed through twenty-five feet of copper tubing surrounded by hot water. He could regulate the dropping of the ether by a needle valve. Brophy used two bottles, one of which contained ether, the other was used simply as a trap by some anesthetists and by others as a container for hot water. There are many other types, more or less familiar, probably giving satisfactory service to at least their originators. One of the greatest difficulties encountered was to construct an apparatus that would not freeze easily, causing delay with the anesthetic and annoyance to the anesthetist.

In the preparation of ether vapor for inhalation there has been ample opportunities for the anesthetists, surgeons and instrument makers to test their ingenuity and mechanical ability to perfect suitable devices. And since, there are now so many different types on the market, with new ones frequently being described which are simple and complicated in mechanism, large and small in size, moderate and expensive in price; I have come to the conclusion that we will soon have as many different types of vaporizers, as we have different kinds of knives for dissecting the tonsil. Each apparatus may prove

*Read during the Organization Meeting of the Inter-State Association of Anesthetists, Cincinnati, O., May 4, 5, 1915.

amply efficient in the hands of its originator, but it is a difficult proposition to have something of this kind that will give perfect satisfaction when turned over to other people and taken care of by non-interested persons around the hospital.

During the past few years there has been a marked improvement in the administration of ether vapor whereever it was indicated, and numerous experiments have been carried out towards placing it on a scientific basis. Dresser placed accurate mixtures of ether and air in rubber bags and this mixture was inhaled by a number of men. "All agreed that 8 per cent. ether vapor was irrespirable, that 9 per cent. caused contraction of the glottis, that 7 per cent. caused irritation and cough, that 6 per cent. was usually respirable." Dresser concluded that a "person in a conscious state should not inhale ether vapor exceeding 7 per cent." Karl Connell developed accurate percentages of ether required for surgical anesthesia given by the vapor method either endopharyngeally or endotracheally. In the beginning 30 to 45 per cent. by weight of ether is required in air, after five minutes it falls, reaching 26 per cent. for the tenth minute when relaxation is established. From now on the percentage goes downward finally reaching about 15 per cent., which of course falls still lower as recovery approaches.

Some anesthestists and operators hold that there is no need to heat the vapor in any form, that by the time it has reached the distal end of the tube the temperature has been sufficiently raised to answer all purposes—that is, it is around room temperature. Such is the case, for by the time the vapor reaches the end of a 3½-foot tube, after passing through a second bottle or a series of coils, the temperature elevation has occurred. In fact, I have found it usually registers by the thermometer within two to four degrees of room temperature. Even with the bottle containing the ether surrounded by ice cold water, the temperature at the distal end of the rubber delivery tube is seldom less than ten degrees F. below room register, while the temperature at the proximal end will be around 45 degrees F. Of course, these readings would vary somewhat, I used a foot bellows to supply the air and passed a constant stream of bubbles through the ether, quite sufficient to freeze ice on the outside of the ether bottle. However, when ether vapor at room temperature strikes the throat of an individual, unless they are completely under by some preliminary method there will be coughing, holding of breath with some cyanosis and usually excessive secretion of mucous. Ether vapor given at room temperature to children upon whom the tonsil and adenoid operation is to be performed, usually causes these irritating symptoms to some degree; no doubt part of it is due to the irritating effects of the vapor itself, and the fact that children of this type are nearly always poor breathers makes it more difficult. It has not been my privilege to see the vapor given by the Alexander-Gwathmey method, where catheters are passed through the nose and the vapor given below the soft palate and the obstructing portion of the tongue. In 1913 at St. Bartholomew's clinic Alexander and Gwathmey were using the oil of orange ether anesthesia; no vapor was given, for as a rule the operative procedures were completed without applying the mask again.

Lately warm ether vapor for intraoral operations has been coming more to the front, to be used after the patient is partially or completely under, and to carry on the anesthesia after it is necessary to dispense with the mask. There are many advocates for the use of warm ether vapor. Both Beck of Chicago and Cain of New Orleans have completed motor driven devices for the giving of warmed ether vapor. Beck's has been used in cleft palate and tonsil work in my own city, the resulting vapor anesthesia was excellent. Caine's was used by Dr. Clyde Lynch while he removed a papilloma of the larynx under Suspension Laryngoscopy at the joint clinical meeting of the American Laryngological, Rhinological and Otological Society held in Cincinnati recently. The warm vapor gave perfect results while the operation was in progress.

Personally warm ether vapor has always appealed to me, that is, vapor brought up above room temperature by some heating device.

1. The vapor itself seems less irritating than the cold, which may be due to lack of concentration.

2. The mucous membranes of the throat are soon accustomed to the warm vapor, so deep inhalations can be taken without discomfort.

3. As a rule there is more rapid recovery and less ether *hang-over*.

4. It does not produce the excessive flow of mucous.

5. A certain amount of the penetrating odor of ether is eliminated, a benefit to both the surgeon and anesthetist.

Failure to find a small device which could easily be taken to the home or from one hospital to another caused me to do some experimenting with the following points in mind:

1. To construct, if possible, an apparatus that would positively elevate the temperature of a mix-

ture of air and ether vapor to at least 98 degrees F. at the end of the delivery tube.

2. To avoid freezing in the air tube immersed in the ether, also in the exit tube.

The vapor was heated by passing it through a series of coils around an electric lamp. This worked fairly well for myself, but I was very careful to keep the shutters partly open, so too much heat was avoided. Also I was careful to see that a continuous flow of air was kept up with the foot bellows. Both Drs. Chas. Cabalzer and A. E. Guedel had trouble while using it with the formation of aldehydes.

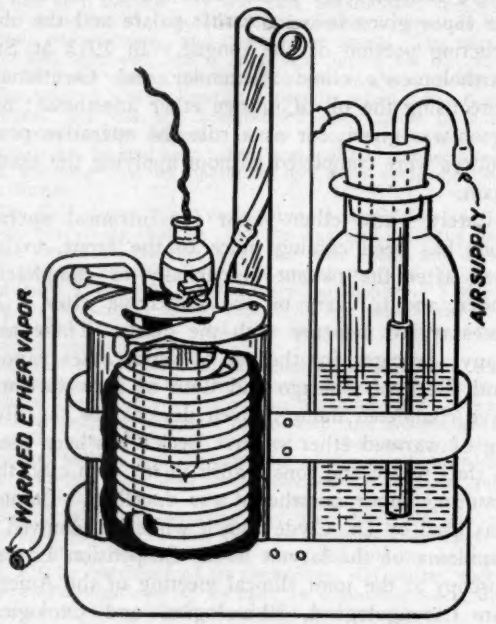

Fig. 1. Author's experimental apparatus, showing carrying device in which the vapor apparatus is handled. The air supply (preferably constant) enters the ether container as indicated, produces the vapor, which is carried through the coil, heated by an electric lamp, and issues from the tube attached to the hose connected with the nasal tubes or mouth gag. Part of the metal side wall of the heating unit has been removed to show the lamp and coil arrangement.

If the electric lamp was allowed to heat the coils sufficiently to produce a mixture of air and ether vapor which would register around 95 degrees F. at the end of the delivery tube a constant stream of air was required; otherwise there would be foreign odors present, the chief of which was aldehyde. Should the air supply be stopped after it had been in use for a short time, the vapors in the heated coils would undergo decomposition and aldehydes could easily be detected when the vapor again came out of the tubing; after the flow had continued a short time, the warm vapor, practically free from foreign ordors would result. Aldehydes will form even at ordinary temperatures in ether when exposed to air and light, and if ether vapor is allowed to stand in heated coils the formation takes place very quickly, rendering the resulting vapor unsafe for administration. Consequently, the apparatus was discarded as far as the heating was concerned. A foot bellows did not supply the air evenly enough to prevent some decomposition of the ether vapor while in the heated coils.

R. M. Isham and C. E. Vail in an article on the oxidation of ether (Journal American Chemical Society, April, 1915) report several facts of interest. They state that the literature on this subject seems to be somewhat incomplete. I found the only reference that would be of much interest to anesthetists would be that of Löw, who has shown that ether vapor, when mixed with air and passed over a heated superficially oxidized copper spiral, is oxidized to aldehyde. Their attention was first directed to the subject when a strong odor of acetaldehyde was noted issuing from a Freas electric oven, in which the residues from the ether extraction of some wheat samples were being dried at a temperature of 110 degrees C. Several experiments were carried out by them to determine the extent of oxidation of ether. They found following two experiments that the oxidation was 2.9 per cent., but more oxygen would be required to secure complete oxidation. When, however, they attempted to use a larger proportion of oxygen with the initial temperature as low as 150 degrees C. the reaction was so rapid that the gas mixture was subject to sudden rises in temperature and subsequent explosions. Consequently they had to abandon the attempt. They have come to the following conclusions:—

"1. That ether vapor is oxidized to aldehyde and acetic acid when heated with air or oxygen.

"2. This oxidation begins at temperatures as low as 110 degrees C. and is very rapid at 160 degrees C."

It is probable that some of the ether vapor would be oxidized at a lower temperature than 110 degrees C., for at that temperature the odor of aldehyde was easily detected.

Therefore, if we expect to have pure ether vapor warmed up to at least 95 degrees F. at the end of the delivery tube, there must be a constant stream of air or air and oxygen supplied, which can best be done with a motor or supply tank, each equipped with a regulating valve. However, the question arises, is it worth while to heat the vapor to this extent? The excessive heating could be somewhat avoided, if one could construct an insulated delivery tube, avoiding the rapid cooling of the vapors. Some of the present warming devices do not deliver the vapor to the patient over 3 to 5 degrees

above room temperature. The vapor is warmed in the heater, but loses most of the heat while passing through the delivery tube.

Another point of interest is the collecting of frost on the outside of the ether bottle when in use for some time, the ether itself is cold and does not vaporize readily. To the best of my knowledge Beck has been the first to overcome this difficulty, which he has accomplished by the use of a low heating hot plate. The ether bottle sets in a container, with one inch of warm water in it. The heat generated is not sufficient to boil the water at any time, but ample to prevent the formation of frost.

In conclusion, in my opinion the newer motor driven devices are most excellent and should be in hospitals where operative work demands the use of vapor anesthesia. Up to the present I have not seen a portable device which can easily be taken from one place to another but what gives more or less trouble when in use for any length of time. My own experients have taught me to watch closely for aldehydes, also some means should be taken to prevent frost from collecting on the ether bottle. These two facts will undoubtedly play an important role in future development of vapor anesthesia, and apparatus for its administration.

PENNWAY BUILDING.

ANESTHESIA IN EPILEPSY.*

W. H. MYTINGER, A.B., M.D.,
CINCINNATI, O.

By the term epilepsy as it is used in my title, I limit myself to the so-called cases of *idiopathic* epilepsy and shall have nothing to do with the *symptomatic* type. This group of patients, formerly little understood, has recently been brought under a scientific classification through the original work of Dr. Charles A. L. Reed of Cincinnati. A definite and constant pathology has been determined and a bacillus has been isolated which is in all probability rightly regarded as specific.

The data for my paper has been gathered from a series of one hundred cases of epilepsy and fifty cases of visceroptosis in which I have administered anesthesia during the past six months. Had the period of time been one of years instead of months, the excuse for this paper would probably not have arisen for it has been the constant recurrence of certain phenomena day after day which has enabled me to draw certain conclusions.

*Read during the Fourth Annual Meeting of the American Association of Anesthetists, Detroit, June 12, 1916.

Just as in his every day life the epileptic presents marked clinical peculiarities, so also in his anesthetic existence do we encounter deviations from the average clinical type. The convulsive seizure so essentially bound up with the disease itself is almost constantly to be dealt with in a more or less modified form and presents the chief difficulty to be overcome.

Habitual constipation due to the pronounced visceroptosis which is constantly present is the rule. This leads to a sluggish circulation and to a reduced power of oxygenation.

An extreme acidosis is present, probably of infectious origin and heightened by the appearance of the epileptic attack. The salivary secretion turns blue litmus red and even after prolonged alkalinization this reaction remains unchanged.

The convulsive seizures under anesthesia show a wide range of variability both as to their nature and as to their number and also as to their time of occurrence and their duration. Profuse salivary and mucous secretion characterize the attack. The swallowing and laryngeal reflexes are excessively active and peculiar throaty sounds are heard which one feels at a loss to describe. The eyes may deviate and lateral nystagymus is often present. The pupils as a rule are contracted and equal, although occasionally one pupil is contracted and the other dilated, while only rarely does one see both pupils dilated which I believe is the rule when the attack ordinarily occurs. The lid reflexes become very active and are entirely independent of external stimuli. The facial muscles may all be involved in this muscular excitation.

The jaws may be firmly locked together and may be fixed over the tip of an enormously hypertrophied tongue which presents excoriations and scars from previous seizures. At other times there is a convulsive grinding of the teeth. At times the tongue muscles are involved and when this organ is hypertrophied and forcibly drawn backwards the act of respiration is almost at a standstill.

Cyanosis of an extreme degree develops rapidly, giving the appearance of impending death for lack of oxygen and which passes rapidly with the lessening in intensity of the attack. The respirations are usually of the stertorous type and are embarrassed to a greater or less degree. Both the rate and the depth of respiration are subject to great variability.

Occasionally the epileptic cry is heard. This occurs as a rule during induction, but on two occasions was distinctly audible during the stage of maintenance. During the induction with the on-

set of a seizure the skeletal muscles may be involved. Those of the back of the neck, the upper and the lower extremities being frequently affected. At times these muscular spasms occur during the stage of maintenance. They may be either clonic or tonic in type, the former type predominating.

The pulse rate and pulse volume are peculiarly independent of the paroxysms. When one sees a deeply cyanotic patient, struggling for breath, he is surprised to find a heart attending to business just as though nothing were going on which concerned it. A rise in rate is noted but not commensurate with the respiratory embarrassment and readily explained on the basis of muscular activity.

As to the number and time of occurrence of the seizures we find a wide range of variation. On two occasions they were absent entirely. Usually at least one seizure occurs during the induction. This may end the attacks for a given case or there may be a series of attacks of longer or shorter duration extending throughout the entire course of the anesthetic. At times there may be an almost continuous chain of seizures with their varying manifestations. It is not an uncommon thing to see the surgeon working in a perfectly relaxed abdomen with the patient blinking his eyes, breathing spasmodically and at times shaking the table with tonic convulsions of the skeletal muscles.

As regards the pathological findings visceroptosis of a high degree is constantly present. This is accompanied by a marked relaxation of the muscles of the jaw, tongue and upper respiratory tract. This relaxation is not comparable to the relaxation encountered in the anesthetic state with the ordinary case. It is so extreme that, in the writer's opinion, it is pathological. This phenomenon has been so constant in all of these cases of epilepsy and also in a series of visceroptosis cases uncomplicated by epilepsy, that the writer is led to venture the opinion that the ptosis is not confined to the abdomen, but that all the ligaments of the body are probably involved. Indeed, on several occasions where this degree of relaxation was encountered and the diagnosis of visceroptosis had not been made prior to operation, I have ventured the diagnosis when the patient was put on the table and it has been verified on abdominal section. The value of this observation is that, given a known case of visceroptosis to anesthetize, we can anticipate a mechanical interference with respiration. The truth of the observation I leave to the test of time.

As regards the anesthetic management of these cases they are uniformly difficult subjects to handle. Prolonged preoperative treatment preferably in a sanatarium or in the home where the atmosphere is conducive of mental quiet and physical rest is desirable. Any influence tending towards excitement of any kind should be done away with.

Intravenous alkaline and dehydration medication should be resorted to combat the existing acidosis over a period of ten days to two weeks before the operation. At the same time bromides or other sedatives should be freely resorted to and frequent courses of vigorous catharsis including high enemata should be employed. At times even after the most careful and persistent efforts to cleanse the intestinal tract on examining the colon at operation it is found practically loaded with hard scybalous masses. An hypodermic of from 1/6 to 1/4 gr. morphin sulphate with 1/150 gr. atropin sulphate has been used in adult cases as a routine. It is of value in combatting the excessive secretion and allaying the severity of the convulsive seizures. Due to the sluggish circulation the absorption seems delayed and the best results have been obtained when given about one hour and fifteen minutes prior to operation.

As to the anesthetic agent to be employed I shall not attempt to lay down any rules. I shall merely give my own procedure and the reasons why I have adopted it.

With the existing high degree of acidosis present nitrous oxid-oxygen would seem to be the anesthetic of choice. However, due to the sluggish circulation, these patients oxygenate poorly. It is exceedingly difficult to maintain abdominal relaxation, so important in these cases, by means of gas-oxygen even when accessory nerve blocking is employed. As a consequence, in order to maintain proper surgical anesthesia and to control the convulsive seizure, one must resort freely to the use of the ether attachment so that the advantages to be derived from this method do not seem to the writer to offset its disadvantages, the least of which is the much greater cost to the patient.

Most of the standard authorities advise the use of chloroform in patients of this class. Chloroform by inhalation is an old remedy for so-called uncontrollable convulsions. Having seen convulsive seizures appear during the stage of maintenance with ether narcosis, I believe that the pushing of chloroform to the point of abolishing the convulsive attack would be dangerous in the extreme.

I have then resorted to the use of ether in these cases using the nitrous oxid-ether sequence with the Bennett inhaler supplementing with oxygen when

indicated. A reasonably smooth anesthesia is obtained and there is no inconvenience to the operator. The induction period is prolonged, due in all probability to the sluggish circulation to the resultant delayed absorption and often to the necessity of waiting for a convulsive seizure to subside before taking the patient into the operating room.

With the onset of an attack during induction a high degree of cyanosis may rapidly develop and it is often necessary to apply the tongue clamp and resort to the use of the pharyngeal tube. In some instances strong support of the jaw will suffice in maintaining an open airway. Throughout the stage of maintenance one must be constantly on the watch for the appearance of convulsive manifestations. The after care of these patients presents no particular difficulty other than the maintenance of an open airway and the nurse should always be instructed to support the jaw until the patient is pretty well out of his anesthetic.

After having administered anesthesia to a number of these patients one gets the impression that he gives a double anesthetic, one to the patient and one to the disease itself for, after the induction has proceeded quietly almost to the stage of narcotization, a convulsive seizure appears and it seems that one begins all over again.

In conclusion, I wish to emphasize the fact that these cases are not choice ones, from an aesthetic standpoint, on which to display your anesthetic prowess. The uninitiated will blame the anesthetist for the epileptic manifestations whatever they may be, even though these are entirely outside of his control. However, one who handles these cases can at least have the satisfaction of work well done for he alone knows and appreciates the difficulties which he has had to surmount.

5 GARFIELD PLACE.

ABSTRACT OF DISCUSSION.

DR. GEORGE W. CRILE, Cleveland, O.—I should like to ask Dr. Mytinger how often, in his series of cases, he has observed covulsions during the induction of anesthesia or its maintenance?

DR. W. H. MYTINGER.—Epileptiform seizure are almost the rule during the induction stage of anesthesia. I have less frequently noted the attacks during the maintenance of narcosis.

DR. F. H. MCMECHAN, Cincinntai, O.—It is interesting to consider whether the method of anesthesia can be made to control the incidence of epileptiform seizures during narcosis. Dr. Cole of Birmingham, Ala., has recently reported a typical seizure of petit mal in an epileptic patient whom he was operating on. It occurred just after the bone flap had been elevated during a decompression under local anesthesia. This would indicate that local or reginal anesthesia is no propylactic measure.

Several years ago during a meeting of the Ohio State Medical Association at Cedar Point I had an opportunity of discussing this subject with one of the women physicians of the Hospital for Epileptics at Gallapolis. She had anesthetized a large number of epileptics for operative procedures in no way associated with their systemic ailment. She had used the open-drop-method of etherization in all her cases; and in practically every instance, she assured me, that either a petit or grand mal occurred during the induction stage of anesthesia, necessitating, as Dr. Mytinger has said, a practical re-induction of narcosis. In a personal communication, a Dr. Green of Georgia, who is in charge of one of the largest hospitals for the epileptic and insane in that state, also corroborated the interesting, clinical points in the behavior of epileptics under anesthesia, which Dr. Mytinger has brought to our attention.

DR. W. H. MYTINGER (closing)—I have nothing further to add, except to mention one point of interest in view of Dr. Meltzer's Observations on the Inhibitory Properties of the Magnesium Salts. Some of the patients in this series of cases received infusions of magnesium sulphate intravenously, but it seemed to have little or no effect in obviating the incidence of the epileptiform seizures. The convulsions occurred just the same. Dr. Cole's case quoted by Dr. McMechan, was probably of the symptomatic type, for which decompression is done; all of the cases in my series were of the idiopathic variety.

SOME BODILY CHANGES DURING ANESTHESIA.*

FRANK C. MANN, M. D.
ROCHESTER, MINNESOTA.

In studying the bodily changes due to an anesthetic or occurring during the anesthetized state, it is necessary to differentiate carefully the effect of associated conditions. The preliminary excitement, struggling, asphyxia and other accompanying phenomena produce changes quite apart from the anesthetic itself. The compensating physiologic mechanism necessary in light anesthesia is probably not the same as when a deep anesthetized state is produced. A short or long period of anesthesia may differ only in degree, provided the anesthetic tension remains the same.

The present investigation deals mainly with a study of the blood of dogs under ether anesthesia. While the associated conditions, as asphyxia, etc., were also included in the study, in general only the results obtained while the animal was under surgical anesthesia will be emphasized.

The blood is the carrier of the anesthetic substance in every method of general anesthesia, and it is important to know definitely how it is affected by each anesthetic either directly or indirectly. This knowledge is of especial value in view of the fact that today more patients than ever before are being operated on under general anesthesia who have a lower hemoglobin content and more pathologic changes of other kinds.

While in the experiments herein reported the methods of etherizing differed, depending on the condition desired, the general procedure consisted in a preliminary etherization in a closed cabinet

*Read during the Fourth Annual Meeting of the American Association of Anesthetists, Detroit, June 12, 1916. From the Laboratory of Physiology, Mayo Clinic, Rochester, Minnesota.

until the animal was completely relaxed, followed by the employment of the auto-inhalation method.[1] The latter consists in intubating in the same manner as for intratracheal insufflation. The intubation tube is connected through a valve tube with a double perforated ether can, which allows of a limited amount of rebreathing. With little effort, constant anesthesia can be maintained in this manner for long periods. .

It was important to determine first whether the amount of circulating blood was diminished. This was estimated according to a method described in a previous publication,[2] which consisted in bleeding the animal from the femoral artery and from the right heart and then comparing the amount of blood obtained with the total amount present in the body, estimated on the basis of 77 per cent. of the body weight. While this method gives only comparative results, it is accurrate enough, when carefully controlled, to show gross changes. In a series of six normal animals which were bled immediately after being etherized, I was able to obtain an average of 76 per cent. of the estimated amount of blood. In a series of six animals which were bled after from six to nine hours of light etherization, only 64 per cent. of the estimated amount of blood was obtained. The decrease in the amount of circulatory fluid would probably have been much greater if deep anesthesia had been employed. The result is due undoubtedly to loss of muscle tone and venous stagnation, as explained by Gatch.[3]

The lipoids of the tissues seem to have the greatest affinity for the most common anesthetic substance. Of these lipoids, lecithin and cholesterin are the most important. The dissolving power of ether and chloroform for these two lipoids has formed the basis for the best known theory of anesthesia. As it has been shown that lecithin is greatly increased in the blood during anesthesia,[4] it was desirable to know whether the cholesterin content of the blood also underwent changes. Accordingly, determinations of the cholesterin value of the blood were made in one series of experiments. The method employed was that described by Bloor.[5] The cholesterin was estimated just before anesthesia, immediately after a stage of prolonged excitement and then at different intervals after etherization. In active dogs the cholesterin content of the blood does not seem to undergo any great changes during a period of time equal to that for which our dogs were kept under anesthesia. In the anesthetized dogs it was found to change considerably, but the variations were not uniform enough to permit definite conclusions. In general, it seems that the cholesterin value increases during excitement, decreases below normal after an hour or so of anesthesia, and then gradually increases above normal on further etherization (Experiment 62).

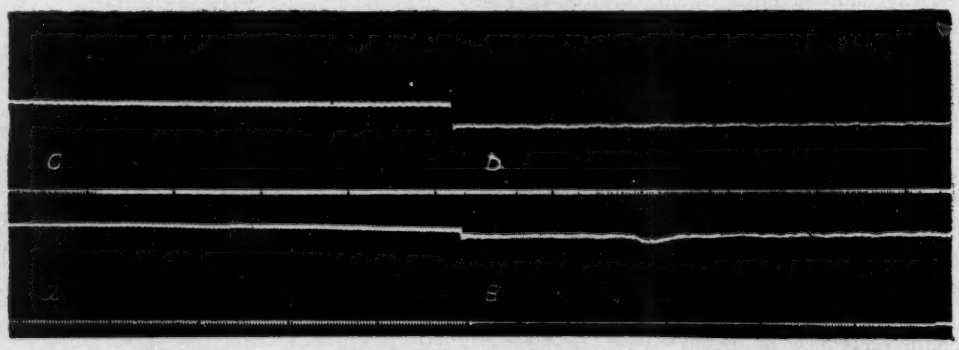

Figure 1. Tracing showing changes in blood pressure under ether. *A* is the record of blood-pressure immediately after etherization; *B* in three hours; *C* in six hours and *D* in nine hours after etherization. During this time the pressure decreased from 105 to 60.

Previous investigation has shown that the viscosity and specific gravity of the blood remain the same under light anesthesia, but both increase when the animal is deeply anesthetized.[6] In several of these experiments the specific gravity was estimated by both the Hamerschlag and the Roy Jones methods, and the foregoing results were corroborated. Under light ether anesthesia the specific gravity of the blood does not change even though the etherization is maintained for as long a period as ten hours. However, when the animal is deeply etherized and respiration becomes shallow, the specific gravity increases a few points in the fourth decimal, probably because of the asphyxia.

As ether and chloroform lake the blood, it has been thought that these anesthetics might have a deleterious effect on the red cells and hemoglobin. This possibility was tested in several experiments. A blood count and hemoglobin estimation were made before anesthesia and at different intervals after etherization. The ordinary hemocytometer

and a Dare hemoglobinometer were used. As a rule, neither the hemoglobin nor the number of red cells underwent changes greater than the coefficient of error, even after ten hours' etherization. In some of the experiments there was an increase in both, but it was slight. In a few experiments the resistance of the red cells before and after etherization was determined by the fragility test of Ribierre.[7] No change in the resistance of the erythrocytes or hyposmotic salt solution was noted.

Leukocytosis occurs in a dog under ether anesthesia, provided the anesthetic is maintained long enough. Occasionally the white cells increase in number within the first hour of anesthesia, but frequently not until after four hours. The increase may be very slight, in some animals not above the coefficient of error, but usually by the end of the fourth hour of anesthesia the number of white cells has doubled. The leukocytosis is not always progressive. Frequently a maximum number is reached which more prolonged etherization does not change. Sometimes there has been a decrease before the end of anesthesia. Usually, however, the number of white cells does not begin to decrease for a few hours after the animal has recovered from the anesthetic, and is still above normal twenty-four hours after etherization (Table 1).

TABLE 1.—CHANGES IN THE NUMBER OF WHITE BLOOD CELLS UNDER ETHER AT DIFFERENT HOURS AFTER ANESTHESIA.

No. of Exp.	Normal Count	First Half Hour	First Hour	Second Hour	Third Hour	Fourth Hour	Fifth Hour	Sixth Hour	Seventh Hour	Eighth Hour	Ninth Hour
51	.....	18,400	.....	.....	19,100	.....	.....	27,200	.....	.....	39,300
52	.....	10,920	.....	.....	14,470	.....	.....	14,520	.....	.....	15,400
53	.....	15,960	.....	.....	13,420	.....	.....	18,340	.....	.....	18,870
54	.....	13,200	.....	.....	14,400	.....	.....	29,900	.....	.....	29,900
60	7,000	.....	8,100	.....	.....	.....	15,000	15,800			
61	10,400	18,400	.....	20,250	.....	.....	39,900				
69	12,150	13,700	.....	.....	.....	.....	24,000	.....	.....	19,000	
70	21,450	25,000	.....	.....	.....	.....	.....	32,750			
71	20,600	.....	.....	.....	.....	23,450					
72	33,850	44,550	.....	.....	.....	.....	.....	.....	50,450		
73	19,800	.....	.....	.....	.....	.....	39,400	.....	46,100		
74	13,300	13,950	.....	.....	.....	36,400	.....	.....	51,300		
75a	20,000	24,800	.....	30,750	35,000	.....	.....	28,330			
75b	8,000	.....	10,000	14,000	17,000	23,830	25,230	25,000	27,000	29,000	
76	14,900	18,700	20,000	26,900	27,900	67,920	29,300	30,000			
77	18,050	.....	18,450	20,000	24,800	28,650	30,500	.....	35,800		
78	21,450	.....	33,650	35,400	44,100	45,000	45,000	.....	.....	40,000	
79	14,000	.....	17,750	21,650	23,850	25,000	21,180	23,050			
81	12,000	18,000	19,250	18,000	21,650	23,300	.....	24,580			
82	26,000	.....	.....	.....	35,000	.....	.....	39,000			
83	25,000	.....	.....	.....	30,000						
85	18,500	.....	.....	.....	20,100	.....	.....	.....	.....	27,100	
86	12,000	.....	.....	.....	.....	.....	19,452				
87	17,000	.....	.....	.....	.....	.....	19,000				
88	16,100	.....	.....	.....	.....	.....	25,400				
89	15,100	.....	.....	.....	30,500	.....	.....	47,450			
90	11,800	.....	.....	.....	.....	.....	19,000				
91	21,000	.....	.....	.....	.....	.....	.....	40,100			

The leukocytosis just described is practically a constant and general phenomenon. It is not limited to the peripheral circulation, for the white counts are usually the same in the blood from ear veins, femoral veins and mesenteric veins (Experiments 54 and 80). This fact, that the white cells are increased in the blood in widely separated parts of the body, also eliminated the possibility that stagnation to dependent parts or reaction to external irritation were factors. Such leukocytosis occurs in animals in which a moderate leukocytosis is present already (Experiment 91). It resembles a leukocytosis of digestion. All of our experiments, however, were performed on dogs that had not had food from twelve to twenty-four hours. It differs from the leukocytosis produced by drugs, such as pilocarpin, in the fact that it is not a lymphocytosis and atropin does not prevent its occurrence (Experiment 77).

The spleen is not an important factor in its production, for it occurs also in animals that have been splenectomized. Its cause and site of action have not been definitely determined, but it would appear that it is a direct stimulation of the bone marrow.

Differential counts of the blood before and after ether show that there may be an actual increase in all of the forms of white cells, but that the polymorphonuclear cells are usually the only form showing also a relative decrease of polymorphonuclear cells noted. The large lymphocytes usually decrease relatively, while the small lymphocytes always decrease. The transitional cells usually show an increase. In one experiment the eosinophils increased greatly. The size and character of all the cells remain normal (Table 2).

TABLE 2.—CHANGES OCCURRING IN THE DIFFERENTIAL BLOOD COUNT BEFORE AND AFTER LONG PERIODS OF ANESTHESIA

Cells	Experiment 75		Experiment 76		Experiment 77		Experiment 79		Experiment 81		Experiment 89	
	Before	After	Before	After	Before	After	Before	After	Before	After	Before	After
Polymorphonuclears	64	86	76	81	78	89	66	86	79	90	76	93
Large lymphocytes	13	5	9	6	6	3	6	6	6	5	10	3
Small lymphocytes	17	2	10	7	7	2	20	2	7	0	5	1
Transitionals	3	6	5	6	6	5	1	3	2	3	4	2
Eosinophils	3	1	0	0	3	1	7	3	6	2	5	1

Studies on phagocytosis have demonstrated that the phagocyte reacts to anesthetics in a manner similar to other unicellular organisms. Fat-dissolving substances, such as ether and chloroform, in weak solutions, stimulate phagocytic activity until a certain optimum strength of solution is reached. Any increase in the amount of anesthetic substance above this produces a decrease in phagocytosis and finally a paralysis of the cells.[8]

In previous studies, the white cells have usually been subjected to artificial environment. They were separated from the blood, suspended in salt solution and, after the addition of the substance with which they were to be tested, such as carbon particles, were incubated for definite periods of time.

It was deemed of value to determine whether phagocytic activity was altered when the cells were

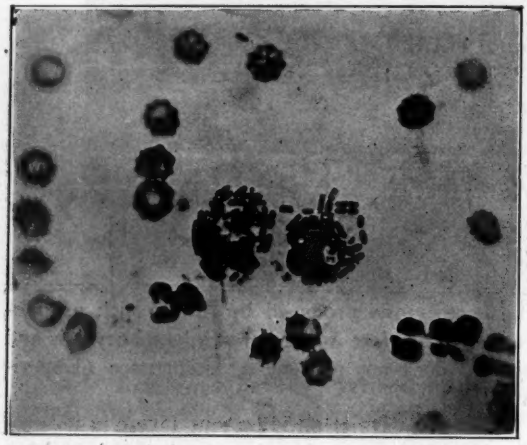

Figure 2. Photomicrograph showing two phagocytes filled with bacteria. These cells had been subjected to five and a half hours of etherization before given access to the bacteria.

subjected to concentration of the ether such as occurs in the blood under surgical anesthesia. In order to make conditions as nearly normal as possible, the following method was employed: Under local anesthesia one of the jugular veins was exposed, dissected entirely free from surrounding fascia and doubly ligated, a section about 10 cm. long being left between ligatures partially distended with blood. A suspension of *Bacillus coli* in salt solution was injected into this natural incubation tube, and after it was thoroughly mixed by rolling gently between the fingers, the skin was closed over the vessel. Under these conditions the blood does not coagulate, the phagocyte remains in its normal medium at approximately its normal temperature, and has access to the bacteria in approximately the natural way. After various intervals of time, an hour being found the most suitable, smears were made. These slides were used as controls. After definite intervals of etherization, the process was repeated on the other jugular vein with exactly the same technic. The cells in the latter vein had been subjected for several hours to a concentration of ether strong enough to maintain the animal under surgical anesthesia.

The blood smears were stained, and a count of the phagocytes containing bacteria and the phagocytes without bacteria was made. Usually 200 white cells were counted on a slide, and frequently counts were made on several slides from one vein. The average was taken as the final result. Only the polymorphonuclear cells were included in this count. The occasional large lymphocyte or eosinophil con-

TABLE 3.—PHAGOCYTOSIS BEFORE AND AFTER ETHERIZATION.

Exp. No.	Normal Count W. B. C.	Count of W. B. C. at Time Bacteria Were Injected After Etherization	Percentage of Cells of Normal Blood Containing Bacteria	Percentage of Cells of Etherized Blood Containing Bacteria	Number of Hours Etherized
87	17,000	19,000	73.5	87	5
88	16,100	25,400	21	36.5	5
89	15,100	47,450	45.5	57.5	5½
90	11,800	19,000	50	50	5
91	21,000	40,100	90	90	6

taining bacteria was ignored. It is obvious that there are chances for error in the method, but I do not believe the average error exceeds 10 per cent.

The results show that phagocytes which have been subjected for from four to six hours to a concentration of ether which is capable of maintaining a dog under surgical anesthesia do not exhibit any marked changes in activity. In most of these experiments the greater number of cells containing bacteria was found in the blood subjected to the ether, but the increase was not sufficient to be of positive significance. It can be definitely stated, however, that there was no decrease in the phagocytic power of the cells in the blood subjected to etherization (Table 3 and illustration).

TABLE 4.—FINDINGS IN EXPERIMENT 54.

	Red Blood Cells	White Blood Cells	Specific Gravity	Hemoglobin	Blood Pressure
Blood taken from peripheral veins:					
Immediately after etherization	5,775,000	13,000	41	70	105
Three hours after etherization	5,437,000	14,400	41	..	80
Six hours after etherization	5,675,000	29,900	41	..	75
Nine hours after etherization	6,020,000	29,900	42	71	60
Blood taken from portal circulation:					
Nine hours after etherization	6,050,000	25,700	42	72	..

SUMMARY.

A study of the blood of dogs subjected to etherization demonstrated the following facts: The amount of circulatory blood is diminished about 10 per cent. after six to nine hours of light etherization. There are variations in the cholesterin values, but the changes are not uniform. The specific gravity does not change under light etherization, and under deep anesthesia increases only as asphyxia becomes a factor. The number of red corpuscles, the amount of hemoglobin, and the fragility of the red cells do not change. There is always a leukocytosis in ether anesthesia. The degree of leukocytosis varies from a very slight increase in the number of cells to more than double the normal number. The increase is usually present after from three to four hours of etherization, and is due mainly to cells of the polymorphonuclear form. The leukocytosis is not dependent on the spleen and is not prevented by atropin. It is probably the result of a direct action on the bone marrow. Phagocytic action is certainly not depressed by an etherization period of from five to six hours.

The following experiments are presented as typical of the series they represent:

EXPERIMENT 54.—July 27, 1915, a young adult female terrier, weighing 5 kg., at 7:55 a. m. was etherized and blood data were taken immediately. The apparatus was arranged to record the carotid blood pressure.

EXPERIMENT 62.—Feb. 19, 1916, female bull terrier in excellent health; weight 17.6 kg.

8:20 a. m.: Blood withdrawn from left jugular vein for cholesterin estimation. Animal very quiet. Cholesterin value, 0.266.

8:21 a. m.: Animal placed in etherizing cabinet and etherized very slowly.

8:50 a. m.: Animal intubated.

8:52 a. m.: Blood withdrawn; cholesterin value 0.312. Animal kept under surgical anesthesia.

9:55 a. m.: Blood withdrawn. Cholesterin value, 0.180. Animal maintained under anesthesia until 3 p. m., when, after another test was taken, it was allowed to recover.

3 p. m.: Blood withdrawn, cholesterin value, 0.358.

EXPERIMENT 77.—April 1, 1916, male mongrel; animal very quiet; weight 15.1 kg.

8 a.m.: Animal was given 1/9 grain morphin and 1/100 grain atropin subcutaneously.

8:30 a. m.: Count of white blood cells was taken.

8:45 a. m.: Etherized quickly by Cone method. Animal maintained under surgical anesthesia until 4 p. m., when it was allowed to recover.

The counts of white blood cells were as follows:

8:30 a. m.,	18,050
10:00 a. m.,	18,450
11:00 a. m.,	20,000
12:00 m.	24,800
1:00 p. m.,	28,650
2:00 p. m.,	30,500
4:00 p. m.,	35,800

EXPERIMENT 89.—May 3, 1916, adult mongrel, male; weight 9 kg.

8:15 a. m.: Count of white blood cells taken from right ear vein and smears for differential count. Right jugular vein exposed under local anesthesia. Doubly ligated vein leaving it almost filled with blood. Length of vein, 8 cm. Total white cells, 15,100. Differential count: polymorphonuclears, 76; large lymphocytes, 10; small lymphocytes, 5; transitionals, 4; eosinophils, 5.

8:30 a. m.: Injected 1 c.c. suspension of *Bacillus coli* into vein. Vein markedly distended. Gently mixed by compression.

9:00 a. m.: Animal etherized.

9:30 a. m.: Smears taken from right jugular vein showed that 45.5 per cent. of the phagocytes contained bacteria and 54.5 per cent. did not contain bacteria.

11:30 a. m.: Took count of white blood cells from right ear vein; count 30,500.

2:25 p. m.: Took count of white blood cells and smears for differential count from abdominal vein. Total count of white cells from abdominal vein, 47,430. Differential count: polymorphonuclears, 93; large lymphocytes, 3; small lymphocytes, 1; transitionals, 2; eosinophils, 1.

2:30 p. m.: Exposed and ligated left jugular vein. Injected 1 c.c. of same suspension of *Bacillus coli*. Technic same as used on right vein.

3 p. m.: Count of white blood cells from mesenteric vein, 46,650.

3:30 p. m.: Smears made from blood of left jugular vein showed that 57.5 per cent. of the phagocytes contained bacteria and 42.5 per cent. did not.

EXPERIMENT 91.—May 11, 1916, young male, mongrel; had had distemper for about four days; weight 8.5 kg.

8:20 a. m.: Exposed left jugular vein.

8:44 a. m.: White blood cells, 21,000.

8:45 a. m.: Injected suspension *Bacillus coli* into ligated vein.

9:00 a. m.: Animal under ether.

9:45 a. m.: Made smears from left vein. Of the phagocytes 90 per cent. contained bacteria.

Animal maintained under surgical anesthesia.

3:00 p. m.: Exposed right jugular vein and injected bacteria.

3:02 p. m.: Count of white blood cells, 40,100.

4:00 p. m.: Made smears from right vein. Ninety per cent. of the phagocytes contained bacteria.

MAYO CLINIC, ROCHESTER, MINN.

ABSTRACT OF DISCUSSION.

DR. ISABELLA C. HERB, Chicago: This is one of the papers of the scientific session that should not be passed by without appreciation, if not discussion. I am pleased to note the tendency to present the more ultra-scientific phases of anesthesia at our meetings, and this is an indication of progress in the right direction. The clinical phrases of the art of anesthesia should not engross all our time; rather, from now on, the theory of anesthesia should be investigated. We are still inclined to place too much value on mere clinical observation without checking up our opinions with laboratory research.

While the question of blood changes under ether has been previously considered, the subject has been by no means exhausted, and what Dr. Mann has presented as his experimental data is well worth mature consideration. It is time that the effects of asphyxia or cyanosis (the concomitants of some methods of etherization) should be dissociated from the real physio-pathology of etherization induced and maintained with proper regard to the thorough oxygenation of the patient under operation.

Some years ago Hamilton Fish pointed out the hazard which anemia projected into the safe conduct of anesthesia, and his conclusion that any general anesthetic is contraindicated if the hemoglobin content is below 50 per cent., is fraught with significance. His contention that the leucocytosis of anesthesia is phagocytic in character is corroborated by Dr. Mann's researches and the photomicrographs he has presented.

Perhaps one of the most important prophylactic measures in the control of shock is the clinical application of the experimental researches of Drs. Gatch and Mann in the preservation of muscle tone to prevent splanchnic stasis.

Also many of Dr. Gatch's contentions about the advantages of light anesthesia are corroborated by these researches into the alterations in the specific gravity and viscosity of the blood, during deep anesthesia and especially when the factors of cyanosis or asphyxia intervene.

The general leucocytosis found during etherization in

Dr. Mann's experiments has been detailed by Chadbourne, emphasized by DaCosta and Kalteyer and corroborated by Casto, who is also of the opinion that it is a result of a direct action on the bone marrow.

If my recollection serves me, all previous investigators rather inclined to the opinion that etherization had more or less of an effect upon the number of red corpuscles, especially the erythrocytes; that the hemoglobin content was altered and that the return to normal was more or less delayed according to the length and depth of anesthesia. It may be that the asphyxial factor entered prominently into these previous investigations; although Casto in experimenting on the human subject and rats under nitrous oxid-oxygen anesthesia has found these changes more or less pronounced.

Recently Mendenhall has been working on the coaglation time of the blood under anesthesia and Crile and Menten have been determining the H-ion content. The sum total of these researches will give us a more thorough understanding of why the preconceived notion that etherization destroyed immunity has abruptly become an open question, especially in view of its therapeutic use in acute infections.

Dr. Mann is to be congratulated on being among those who are rewriting the physio-pathology of anesthesia.

I should like to ask Dr. Mann whether the specific gravity of the blood was lowered when a great deal of oxygen was given with the anesthetic and also whether a closed method of etherization was used in the experiments?

DR. F. W. NAGLE, Montreal, Canada: I want to ask Dr. Mann whether I understood him correctly to say that there was no leucocytosis or hemolysis in the first hour of etherization. If I remember correctly Hamburger and Ewing found considerable hemolysis, even after only one hour of ether administration.

DR. WALTER M. BOOTHBY, Boston, Mass.: At the meeting of the Pharmacological Society last winter and also the year before, I strongly urged that in experimental work dealing with etherization the dosometric method of administration should be employed. Apparatus is available for this purpose. If Dr. Mann could state what anesthetic tension his animals had been under and for how long, his results would be comparable with others for future reference and experimentation. Such work as his is too painstaking not to have the slight additional expense of an accurate dosimetric method of administration. Even if not used in the clinic it should always be used in experimental work.

DR. F. C. MANN (closing): In answer to Dr. Herb's question I would say that when anesthesia was light with no asphyxia, there were no changes in the specific gravity of the blood. Dr. Nagle understood me correctly; I did not find hemolysis. The method of anesthesia used was the auto-inhalation method devised by McGrath. While dosimetric methods may be ultra-scientific, in these experiments an effort was made to approximate the method of etherization to that usually employed in anesthetizing patients in surgical clinics. Dosimetry would certainly add a valuable control to the experimental results.

Whatever differences there may be in the results of these researches and those of previous investigators, are due, probably, to some extent, to the fact that our experiments were conducted under an improved method of etherization. The physio-pathology of anesthesia offers many interesting phases for research and we hope to continue our experiments along lines that will make their results applicable to the improvement of anesthetic methods and surgical procedure.

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SPECIAL EDITORIAL COMMENT.

The subject of Blood Changes under Anesthesia and Analgesia has been exhaustively dealt with by Theodore D. Casto in an article in the American Year-Book of Anesthesia and Analgesia. All previous investigations of importance have been reviewed and Casto's own researches and those of Mendenhall, Menten and Crile incorporated. Also the Year-Book contains papers by F. C. Mann on the Peripheral Origin of Shock and by W. D. Gatch on Circulatory Disturbances due to Laparotomy, Posture and Anesthesia. These papers give the reader an insight into the mechanism of diminished blood-flow, splanchnic stasis and the role of light surgical anesthesia in preserving intra-abdominal pressure and the proper degree of muscle tone.—Editor.

CHLOROFORM-ETHER SEQUENCE WITH A SUMMARY OF RESULTS TO DATE.*

RALPH P. BEEBE, M.D.,
KALAMAZOO, MICH.

The subject of surgical anesthesia is far from being a closed chapter. In eighty-five per cent. of all operative procedures, the anesthesia is the most serious feature and often the life of the patient rests with the anesthetists, a fact which is not generally appreciated. Improvements in surgery are not all confined to the development of operative technic. The experienced operators today take into consideration not only the gravity of the operation but also the immediate and remote effects of the anesthetic, and for this reason he is associating in his team-work an expert anesthetist, from whom he demands the qualifications of a specialist. The surgeon is not alone in this reform; the public is also demanding better service in anesthesia, and that is the reason why the status of the anesthetist is gradually, however slowly, assuming the importance and dignity it deserves. If the anesthetist wishes to render his position secure he must study and put into routine practice the most improved methods of anesthesia available for cooperating with his surgical confreres and for satisfying the public and holding its confidence.

The past has presented us with over five hundred substances, combinations and mixtures for general, local and anociated anesthesia (Gwathmey). I

*Read during the Fourth Annual Meeting of the American Association of Anesthetists, Detroit, June 12, 1916.

mention this to show that up to the present even routine methods of anesthesia have not been entirely satisfactory. Of all these agents for anesthesia, only a few have achieved any standing during the past seventy years, and of these ether and chloroform have been the most frequently used in general surgery.

One of the greatest changes in the Middle West during the past decade has been the comparative passing of chloroform from routine use and the substitution of ether. The bugbears of etherization—pneumonia and nephritis—have been lived down. There have been so many mishaps from the use of chloroform, so many near-deaths, actual fatalities and post-anesthetic toxemias, that its use has been gradually abandoned. While certain dangers always present in the use of chloroform, they have been exaggerated on account of the lack of instruction in medical schools on the art of anesthesia and the proper administration of anesthetics. Authoritative literature on the subject was also lacking. Nearly all works on surgery and therapeutics ignored the subject, treated it slightingly or simply compiled all the fallacies from the time of Sir James Y. Simpson, interspersed with a few truths.

The past few years have witnessed a great change, however. Noted surgeons, chemists, physiologists, anesthetists and dentists have studied anesthesia in all its phases and have finally placed its theory and practice on a scientific basis of laboratory research and clinical corroboration. And the end is not yet. These researches and their clinical application are being enthusiastically continued.

Some of the methods developed in these investigations can only be acquired and used by the most expert and at the expenditure of considerable cost for the equipment. While undoubtedly alluring to all, they cannot be used routinely by the average physician who is called upon frequently to administer anesthesia for operations in his immediate community. Among the methods available for this purpose is the chloroform-ether sequence by the drop method, which has stood me in good stead, and to some details of which I wish to call your attention.

TECHNIC OF THE CHLOROFORM-ETHER SEQUENCE.

In the preliminary administration of chloroform in this sequence, chloroform is dropped upon an Esmarch, Yankauer or similar mask, until the patient is anesthetized to the stage of unconsciousness. The reflexes are now in abeyance. The change to ether is made abruptly. A modified Allis inhaler is used. This modification consists in stringing copper wires across the interior of the mask to support the gauze, instead of weaving the gauze on the old-style inner frame. The amount of gauze should be equivalent to nine or ten thicknesses of loose-mesh surgical gauze, and should be laid in lightly, but blosely around the edge of the inhaler so as to catch every drop of ether.

Ether is dropped, slowly or faster, as the exigencies of the anesthesia or the operative trauma require. During the transition the ether must be dropped rather briskly until a surgical plane of narcosis is reached; otherwise the patient may show signs of coming out. Properly administered by a steady, continuous dropping of the ether, the gauze will not become too saturated and interfere with the proper volatization of the anesthetic. The continuous administration, regulating the rapidity of the ether dropping, will enable the anesthetist to hold the patient in any desired plane of anesthesia.

Perspiration and the accumulation of mucous are both signs of too concentrated a vapor. The face should be kept dry and the mouth cleansed of mucous with a gauze swab, or by turning the head to the side to let the secretions flow out of the angle of the mouth. It should be the constant effort of the anesthetist to keep the patient's color as pink as possible, as this is an indication that while the concentration of the anesthetic vapor is sufficient for surgical narcosis, it is not sufficient to prevent the proper and necessary oxygenation of the blood and tissues.

ATTITUDE TOWARD THE PATIENT.

Successful anesthesia depends in large measure upon the attitude of the anesthetist toward the patient, which should be sincere and gentle, however firm. Mystery is disconcerting to all patients, so it is the better part of discretion to inform them why such details as covering the eyes are done. If told what their sensations will be while going under and how to facilitate the onset of unconsciousness by proper breathing, they will be handled all the more readily. There is no reason why the patient should not be anesthetized on the operating table. While some may object, through fear or ignorance, the majority will readily consent after a proper explanation. Except for being placed in the posture required by the operative procedure, patients should not be moved during the induction or maintenance of anesthesia, as such movement may cause nausea and vomiting; may alter the plane of narcosis and necessitate a prolonged induction or reestablishment of the proper depth of anesthesia, at the expenditure of a larger amount of the anesthetic and to the detriment of the uneventful recovery of the patient.

I may seem prolix in emphasizing the advantages of strict attention to details, but I know from experience that this painstaking care not only goes a long way in determining the smoothness of the anesthesia, but also does much to gain the patient's confidence.

RESULTS.

I have anesthetized twenty-four hundred patients with the chloroform-ether sequence. Of the last two hundred cases I have kept a complete record.

One of the greatest annoyances to both patient and anesthetist is post-anesthetic or post-operative nausea and vomiting. While occasionally this complication may be due to acidosis, peritonitis, gall-bladder infections and operative trauma, in a certain definite percentage of cases it is due to preliminary morphinization or the anesthetic. Of the two hundred cases recorded, sixty-one or about 30 per cent. were nauseated or vomited. A few vomited during the induction of anesthesia; the remaining on returning to consciousness or soon after their return to bed. In six instances the vomiting was severe, interfering with the administration of the anesthetic or continuing from six to twenty-four hours after the patient's return to bed. The incidence of nausea and vomiting in the twenty-four hundred cases was considerably higher than the percentage in the recorded cases.

AMOUNT OF ANESTHETICS.

The amount of chloroform necessary during induction is rather uniform, being from one to two drams, or on an average one and a half drams to secure the stage of unconsciousness. In eight cases of the series it was necessary to return to chloroform after attempting the transition to ether, but in these instances all the cases were alcoholics. The chloroform was dropped into the Allis inhaler, from fifteen to twenty minims being used.

The amount of ether required varied with the types, mentality and physical condition of the patients. Some exhibited decided idiosyncrasies, and for these the variations in amount were extreme. A difference in the amount used also varied with the products of the different manufacturers. The average amount of ether used during the first hour was four ounces, and a less quantity for each succeeding hour.

COMPLICATIONS.

There was one case of post-operative pneumonia in the series of recorded cases. A woman, aged 30, who had been operated on for hernia and appendectomy. She recovered.

Suppression of urine occurred in a woman aged 40, who was operated on for strangulated hernia in the presence of a chronic nephritis. She took the chloroform shabbily, but the ether very well. She recovered from the anesthesia without nausea, but complete suppression of urine set in the second day after operation and the patient only lived five days.

ADVANTAGES.

I do not claim that the chloroform-ether sequence is the best method of anesthesia, but merely that it is one of the best. In certain cases I administer chloroform and ether separately with very good results. The modern conception of the physiopathology of the various anesthetics and methods is enabling us to suit the anesthetic and method to the condition of the patient and the requirements of the operative procedure, to the advantage not only of the surgeon, but also the increased well-being of the patient.

I do claim for the chloroform-ether sequence simplicity, cleanliness and safety. It is also a method that the average physician, with ordinary ability, can master with little practice. There are very few physicians who are not compelled, occasionally, through circumstances to administer anesthetics. For them this is the method of choice.

In conclusion the anesthetist should endeavor to consider the safety and comfort of the patient primarily, and use that method which he can master and wherewith he can assure the recovery of the patient and satisfy the demands of the operating surgeon as well.

ABSTRACT OF DISCUSSION.

DR. F. W. NAGEL, Montreal, Canada: I was much interested in Dr. Beebe's description of his apparatus and I thing he would be interested in one devised by Dr. Howell, in which two tubes, fitting on top of each other, are connected with the vaporizing chamber of the inhaler. The extra length of tubing is of especial advantage in enabling the anesthetist to concentrate his vapor if he finds occasion to require it.

DR. RALPH BEEBE (closing): I appreciate Dr. Nagel's calling my attention to Dr. Howell's modification of the inhaler. Personally I also think it an improvement to put the wires above the center of the inhaler to provide a larger air-space below. Several strands of wire are amply sufficient to hold the gauze and no impediment to breathing or vaporization of the anesthetic is introduced.

SPECIAL EDITORIAL COMMENT.

The January Supplement will contain some of the papers of the Symposium on Anesthesia for Oral Surgery, read during the Joint-Session of the Interstate Association of Anesthetists and the National Dental Association.

ALCOHOLISM AND DRUG ADDICTION AS COMPLICATING FACTORS OF ANESTHESIA.*

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Alcoholism and drug addiction are two of the most prevalent annoyances with which the anesthetist has to contend. They not only involve an extra hazard of life, but often jeopardize the satisfactory conduct of anesthesia and the operative procedure, and not infrequently precipitate untoward incidences into recoveries that otherwise should be uneventful.

Both conditions are no respectors of sex or social status and are encountered among the dregs of the humblest dispensaries as well as the aristocratic clienteles of the most exclusive hospitals. Both can be properly dealt with if previously recognized. Concealment, whether through ignorance or design, always proves disastrous.

In these days of propaganda for reform in everything it is essential to emphasize the fact that alcoholic and drug addicts, coming to operation under anesthesia, must be accepted as such and handled accordingly. Misdirected efforts at reformation invariably cause more danger and distress than the original complications involve.

In the routine surgery of alcoholics or drug addicts it is imperative to allow them their usual daily requirement of liquor or opiate. Such consideration will not only conserve what remnants of vital forces these derelicts still possess, but it will also render them manageable. On the contrary efforts at withdrawal or reduction below the minimum per diem requirements of alcoholic saturation or drug balance, will result, either in disconcerting nervous exaltation or imperiling physical collapse.

In the surgery of election, preliminary withdrawal or reduction may be tried, provided no operative procedure is attempted until the alcoholic or drug addict has reestablished a fairly normal condition. Such preliminary treatment is not a matter of a few days of alkaloidal medication and violent purging, as is advocated by some, but a long, tedious, restorative process, involving a complete reversal of metabolism, a resumption of functional activities and the elimination or control of psychopathic factors. This chapter on the cure of the alcoholic and drug addict remains to be written. Until this has been done, the surgeon and anesthetist must accept these extra-hazardous risks as such and give them the full benefit of every possible measure of conservation.

While alcoholics and drug addicts are both difficult subjects to handle under general anesthesia, the method of managing each and the respective dangers involved are somewhat different.

In many respects the effects of alcoholism on the tissues and organs resemble the results of strangulation. Even the casual observer realizes that the alcoholic is continuously underoxygenated, if not persistently cyanosed. The alcoholic is so hazardous a surgical and anesthetic risk because alcoholism affects all the protective forces and eliminative resources of the body.

Chronic alcoholism causes the following pathology:—

1. A persistent form of general acidosis.
2. Arterio-sclerosis and cardiac hyperthrophy.
3. Increased intracranial pressure and edema of the brain.
4. Cirrhosis or fatty degeneration of the liver.
5. Intermittent nephritis.
6. Cortical degeneration of the adrenals.
7. Increased susceptibility to infection.

In the preparatory regime of alcoholics for any operation under general anesthesia, it seems needless to reiterate the efficiency of the several measures for the control of acidosis. Carbohydrate feeding with the addition of fruit-juices and alkaline waters are always indicated. In toxemias associated with alcoholism glucose solutions should be given by rectum in conjunction with Fischer's solution intravenously in the presence of nephritis or edema.

In alcoholic "wet brain spinal puncture and withdrawal of fluid under sphygnomanometric control, according to the practice of S. P. Kramer, is an valuable in almost immediately relieving the symptoms of acute delirium tremens or alcoholic coma. Kramer, Hogan and Fischer now favor replacing a portion of the spinal fluid with bromid solution. This remedial measure is available not only in the preparatory regime, but also in the control of post-anesthetic sequelae.

Care must be exercised in preceding general anesthesia in alcoholics with hypnotics. While chloral, morphin, hyoscin and other drugs are available, they must be used with discretion and fortified with cardiac stimulants. Apomorphin is preferable to morphin and paraldehyde by rectum more satisfactory and less dangerous than chloral. Owing to the effects of alcoholism on the adrenals and brain, pituitrin is a veritable sheet anchor in all emergencies involving embarrassment of the circulatory system. Pituitrin replaces ergot, which has established

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itself in the treatment of alcoholic complications, and provides all the advantages of adrenalin without its influence being evanescent.

The alcoholic is a patient already partially under the influence of an anesthetic. Unfortunately the excitement stage of alcoholic narcosis is far more prolonged than that of any other anesthetic, and the effort to administer nitrous oxid, ether or chloroform, not only exaccerbates the pugnaciousness of these unmanageable patients, but almost invariably precipitates the following symptom-complex:—

1. An ascending degree of cyanosis. .
2. An increase of excitation.
3. Tonic or cloninc spasms of the musculature; embarrassment of respiration; asphyxia and abrupt cardiac arrest, *or*—
4. Over-ventilation, followed by
5. Acapnia with pallor, apnea and gradual cardiac exhaustion.

The fact that alcoholics are under and out of anesthesia with disconcerting rapidity makes chloroform an especially dangerous anesthetic for these hazardous risks, because its administration invites the incidence of cardiac fibrillation.

While experts can handle alcoholics under nitrous oxid-oxygen anesthetics, with or without supplemental etherization, the method is extrahazardous as a routine and the margin of safety so narrow as to invite disaster. It is almost impossible to avoid imperilling cyanosis in alcoholics under nitrous oxid-oxygen, and this cyanosis, aside from its untoward results, may abruptly terminate in asphyxia and cardiac dilatation during the stage of excitement and struggling.

Two technics of anesthesia offer a safe and efficient method of narcosis for alcoholics:—

1. The Essence of Orange-ethyl chlorid—C_1E_5 Mixture by the semi-open drop method with concomitant oxygenation and
2. Ethel-Oil Colonic anesthesia (Gwathmey) with the preliminary use of paraldehyde.

The former is satisfactory because the Essence of Orange obtunds the inconvenient airway reflexes, so conspicuous in alcoholics, the ethyl chlorid obviates cyanosis and the C_1E_5 mixture gives all the advantages of these agents used separately, without any of their disadvantages. Concomitant oxygenation enables the anesthetist to prevent mild grades of persistent cyanosis and to induce and maintain, with less danger, a deeper and more satisfactory plane of surgical anesthesia. The semi-open method of administration gives just sufficient rebreathing to conserve the requisite carbon dioxid tension to prevent acapnia and apnea as a result of overventilation should struggling and excitement supervene.

Ether-Oil Colonic anesthesia is a satisfactory routine method, especially in the obese and plethoric type of patients. The minimal effect upon the brain and kidneys of this method and its freedom from respiratory reflexes, provided an open airway is steadily maintained, make it a technic of exceptional value.

Postoperatively alcoholics recover from anesthesia by crisis, but they are very subject to untoward sequelae. These must be combated by the remedial measures already indicated in the preparatory regime.

Provided the narcotic addicts' drug balance is painstakingly conserved, they will withstand anesthesia and operation with impunity. Bishop, the greatest authority in this matter, has formulated the following dictum:—

"The reduction of a drug of addiction below the amount of body need robs the addict of his most valuable asset in securing and maintaining recuperative powers."

Drug addicts are present in several types, each of which require a somewhat different method of handling.

1. Those addicts, who, except for the habitual use of opiates and a psychopathic taint, are otherwise practically normal.
2. Those addicts who use opiates to control the pain or symptoms of certain diseases, such as malignancy or diabetes, and
3. Those addicts, in whom the use of opiates is merely one phase of an entire moral and physical degeneration.

The first class react to anesthesia in almost the same manner as alcoholics. In handling them it is important to make their drug addiction serve the useful purpose of preliminary hypnotic medication. Each case should be studied in order to so arrange the dosage of the opiate that the period of somnolence will coincide with the induction stage of anesthesia. If induction is attempted during the excitement period of the narcotic, addicts are quite as unmanageable as alcoholics.

In the second class of addicts every effort should be made, unless an emergency exists, to put the addict into approximately normal condition before operating. These patients and the derelicts in whom the toxemia of infections and the ravages of malignancy have depleted the body of all the forces of resistance and recuperation, should be given the benefit of nitrous oxid-oxygen anesthesia. These patients must be persistently over-oxygenated, as their tendency is toward exhaustion of the circulatory and respiratory systems on account of the depletion of tissue respiration.

If these addicts show a breathing test of less than from 30 to 40 seconds, they should be considered unfit risks for general anesthesia.

In conclusion it may be stated as a working principle that alcoholic and drug addicts should be operated on under local or conductive anesthesia, except in the presence of infection or a tendency on the part of the tissues to slough, and only under general anesthesia when no other method of narcosis suffices for the required operative procedure.

When alcoholics or drug addicts are operated on under general anesthesia, they should have all the advantages of a thorough preoperative regime, a cautious and painstaking anesthesia and a carefully guarded recovery.

Alcoholism is one of the important factors in the morbidity of surgery and anesthesia that still defies the skill of the operator and the precautions of the expert anesthestists. Its elimination is a desideratum devoutly to be wished.

ABSTRACT OF DISCUSSION.

Dr. E. I. McKesson, Toledo, O.: I think that the trouble is that we do not know when we have an alcoholic. The patient comes to the table; and then for the first time we discover in three minutes that he is one. Therefore it has been my practice for the last two or three years, to divide the preliminary medication into two doses, giving a dose two hours before the operation. An hour after I judge, either personally or by report from the nurse, as to the effect produced by this first dose, and gauge the second dose accordingly. In this way, you have a little chance with an alcoholic by starting the preliminary medication long enough beforehand to control the alcoholic reaction by the second dose of the hypnotics. You will find a great many patients who are addicted to the use of morphin or opium in any of its forms, who are afraid to take their usual dose on the morning of the operation. They may not tell the surgeon, the anesthetist or anyone else that they are habitues; but if they come to the operating table without some method having been used to discover this fact they will have an underdose and make very unsatisfactory cases. Again, the concealment of the drug habit may lead to overdosage in the preliminary medication.

Dr. Chas. K. Teter, Cleveland, O.: I think that the most important thing in this paper from the standpoint of the anesthetist is that patients should have their usual dose of the drug they are addicted to on the day of the operation. A number of years ago, in a discussion of this subject, a number of anesthetists said that if a patient were an alcoholic, he should not have any of his favorite beverage given to him on the morning of the operation; but it seems that we have come to the conclusion now that it is best not to withdraw the dose, whether the patient uses alcohol as a stimulant or takes opium in some form.

Dr. C. C. McLean, Dayton, O.: I have surely enjoyed the paper very much, and I was wishing that Dr. McMechan would say just what was meant by drug addicts and alcoholics. We have all had our troubles, I think, with users of opium and alcohol, but I wonder if any of you have had any experience with a person who has been in the habit of using ether and chloroform. A few weeks ago I was asked to give an anesthetic in a case in which they had failed to anesthetize the patient the day before. I forget how much ether he had had, but it was plenty. It was a tonsil and adenoid operation. The patient was sent into the hospital, and I had my apprehensions as to what we could do. I am in the habit of giving the ether or ether and chloroform by the Gwathmey vapor method in the tonsil and adenoid work. I got the patient anesthetized to an exaggerated excitement stage, but not deeply enough to insert the mouth-gag and go ahead with the operation. We had to stop. I forget how long we were at it, but it was quite a while. The patient was a drug clerk, we found out afterwards, and was in the habit of inhaling chloroform and ether.

Dr. F. H. Nagle, Montreal, Canada: I would ask whether Dr. McMechan has had any experience with patients who have been alcoholics or drug habitues, but had given up the habit several years before the operation. I have had a number of cases of that kind, and in each case I had considerable trouble in the induction of anesthesia.

Dr. McMechan (closing): Dr. McKesson's point, I think, is well taken. It is only necessary to emphasize the fact that concealment of alcoholism or drug habituation is the thing to be feared. It should get out among surgeons and the laity that the anesthetist should be told. The nurses and physicians in these cases should not hide the fact. It is surprising how well a morphin addict will stand the most gruelling operative procedure, if he has managed to conceal about his person or the bed a sufficient amount of morphin to carry him through his stay in the hospital, which serves to emphasize Dr. Teter's remark that the usual dose of opium or alcohol should be administered.

With regard to Dr. McLean's experience with an ether and chloroform addict, I would state that reports have come in from several of the base hospitals in France in which certain surgeons and anesthetists are having considerable difficulty in anesthetizing ether drinkers. Apparently the only countries in which this habit is still prevalent are a few districts in France and one or two in Ireland. How it originated and why it continued, I do not know, but some surgeons in the war zones are getting just as unfavorable results from their efforts to anesthetize these ether drinkers as Dr. McLean experienced with the drug clerk.

Regarding the length of time that the alcoholic taint, so far as it pertains to anesthesia, persists, I would say that in the chronic old boozer, such as Dr. Nagel referred to of the type that you meet in the municipal hospitals and dispensaries, you will get the alcoholic reaction, irrespective of the time that he had given up the use of alcohol. I have had Dr. Nagel's experience in men who have reformed and have not touched liquor for ten years, according to their statement, but whether they spoke the truth or not I cannot say.

TO READERS OF THE SUPPLEMENT

¶ While the pages of the Supplement are replete with invaluable suggestions for advancing the science of anesthesia and analgesia, the advertising sections of the American Journal of Surgery contain many valuable pointers regarding apparatus, drugs, agents, and accessories that fulfill many of the requirements in the practice of these specialties.

It will be of interest then to the readers of the Supplement to refer to these advertising sections for anything they may need in the practice of their specialty.

No member of the profession is well equipped for the practice of his specialty unless he is familiar with the latest innovations that apply to his chosen field of endeavor.

THE ESSENCE OF ORANGE-ETHER VAPOR SEQUENCE BY THE CLOSED METHOD.*

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There is a wide difference of opinion among surgeons and anesthetists of large experience as to the method of choice in the administration of ether. This diversity of opinion but accentuates the fact that the ideal method is yet to be discovered. The methods in common use have their adherents who present various substantial reasons for adopting one or the other as the method of choice, and it is but natural for one to strongly recommend the method with which he has obtained the best results through skillful administration. Aside from other important considerations, there is one factor, the expert knowledge of administration by any particular technic, which is often overlooked or not mentioned in discussing the merits of any form of administration. In this connection familiarity in the use of any particular method of administration, not only has a direct bearing on anesthesia statistics, but no doubt accounts, in great measure, for the decided opinions which are expressed as to the relative merits of the different forms of administration.

From a practical standpoint the administration of ether resolves itself into two methods: the open and the closed, with various modifications, to suit individual preferences. It is claimed that in expert hands either of the methods herein discussed unless especially contraindicated can be used with practical equal safety. While the open method of ether administration has been used extensively in very large clinics and has a great many supporters among surgeons and anesthetists of unquestionable repute, well founded objections have been raised from time to time to the use of the open method of ether administration.

The advantages set forth by the enthusiasts of the open drop method are, the wide limit of safety, a method which is certain in its action, and requiring no cumbersome or expensive apparatus; these consequently will permit its administration in case of necessity by the untrained.

Open ether unquestionably has its limitations in spite of the fact that it is the routine method of choice in some very large and prominent clinics. A tendency seems to have developed to employ the open drop method to the exclusion of all others, thus suiting the patient to the anesthetic rather than the anesthetic to the patient.

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No one who has had any considerable experience with really open ether will deny that the following are the usual objections urged against the method:

1. A long unpleasant period of induction, particularly in robust subjects and alcoholics.
2. Cold vapor from a dripping frosted mask, affording a very poor surface for vaporization.
3. No rebreathing with the consequent absence of CO_2 stimulation.
4. Waste of ether.

To quote from Bryant and Henderson: "It is not at all unusual to see a patient who throughout a prolonged operation, such as a difficult gall-bladder or stomach operation, has had a really open ether anesthesia leave the table with skin pallid, covered with cold perspiration and more or less in a state of shock, and in whom recovery is slow and incomplete. His post-operative course is characterized by intense nausea and prolonged vomiting and the distressing abdominal distention. He becomes a subject requiring constant attention, and may even result fatally."

The closed method of ether has its disadvantages as set forth in an article published by Coburn from the Anesthesia Commission of The American Medical Association:

1. Disagreeable and prolonged induction.
2. Decreased oxygenation and increased CO_2.
3. Impossibility of regulating the dosage because of the necessity of pouring the ether into the inhaler intermittently.

The method that I desire to call to your attention overcomes each and every one of these objections and is based upon careful observation and study of three hundred administrations of the essence of orange-ether vapor sequence by the closed method. Most of the cases that were employed for the study of this method were limited to operations lasting one hour or more and were administered exclusively in hospital practice, so that we were able to carefully follow their post operative course. This series comprised: 49 gall bladder operations, 28 operations on the stomach, including resections and gastro-enterostomies, 16 kidney operations, 43 abdominal hysterectomies, and 74 lengthy vaginal plastic procedures.

Woolsey of Brooklyn developed and perfected the method herein described. His technic differed from that of the writer's only in the fact that he employed a foot pump for his air supply instead of an electrically driven pump. He sets forth the following virtues of the vapor method: small amount of ether consumed, continuous plane of

narcosis, ether dosage is more constant and controllable, warm and moist vapor.

Woolsey, Gwathmey and the writer have used the method in over one thousand cases, not only without a fatality, but without uneasiness at any time.

The method approaches the ideal conditions because it furnishes a volume of air sufficient for respiration with a minimal concentration of ether vapor necessary to induce and maintain anesthesia.

The disagreeable induction is eliminated by proceeding the administration of ether by oil of orange vapor. The induction period is thus deprived of its terrors, the subject lapsing quietly into unconsciousness when the vapor is turned on. To quote from Gwathmey, the physiological basis for the beneficial effect of the oil of orange in the administration of inhalation anesthetics may be found in its prevention of reflex stimulation by the anesthetic agent of certain sensory nerves. The induction may be compared as with a good nitrous oxid-oxygen-ether vapor sequence and its duration averaged six minutes in this series. In my series of three hundred cases, struggling manifested itself appreciably in only one case. The period of excitement is absent or reduced to a minimum. I believe that struggling can be nearly always eliminated and the second stage be bridged over by the very gradual addition of ether vapor. Difficulty in inducing anesthesia arises when the early dosage is so irritant as to cause coughing, light breathing, or holding the breath. A marked second stage is the fault of the anesthetist and not the method.

Decreased oxygenation does not pertain when ether is given in this way. The patient is sufficiently oxygenated at all times and there is no cyanosis at any time. Anoxemia or oxygen deficiency can not occur when the air supply is forced into the bag by an electric motor and blower. The air supply is constant and unvarying. Rebreathing is continuous, and a part of the rebreathed air escapes constantly. In the light of recent research, partial rebreathing is of distinct advantage. The stimulating effect of CO_2 upon the medullary centres is convincing evidence as to the value of rebreathing. Clinically this fact is evident enough, and it is unquestionable that rebreathing small quantities of CO_2 is an efficient means of maintaining respiratory and cardiac function and preventing or alleviating surgical shock. Clinically I have been able to demonstrate the value of rebreathing repeatedly in a great many grave surgical risks. After a two hour procedure involving the upper abdomen, such as resection of part of the stomach for carcinoma, the patient leaves the table with color excellent, skin warm and dry, breathing quiet and regular, and with a pulse strong and little, if at all, accelerated. Recovery from the anesthetic is, as a rule, prompt and complete, and from personal experience, I can say that the period of recovery is shorter than by any other method of ether narcosis. Return to consciousness is marked by the absence of prolonged nausea or vomiting. Carefully kept records of my series showed that 27 per cent. of the patients vomited after being returned to bed. The majority of this number vomited only once before consciousness had fully returned.

It is an unquestionable fact that anesthesia is good in proportion to its uniformity. The administration of any anesthetic should be as nearly uniform as possible throughout its entire administration. Anesthesia accidents do not as a rule occur when a uniform deep anesthesia is maintained, but come particularly to those who administer irregularly, thus permitting the patient to come out of the anesthesia and again plunging him into deep narcosis. This objection is overcome by the continuous and even administration of ether vapor. Thus the ether dosage is constant and under complete control of the anesthetist. The depth of the anesthesia never varies, always even and tranquil; the ether vapor is constant in strength, moistened and warmed, thus conserving a considerable amount of body heat. The anesthetist can carry the patient at a low level of anesthesia, changing rapidly to a higher, as required by particular exploration or manipulations.

From a rather extensive personal experience with the various methods of ether administration, I am satisfied that with no other method of ether anesthesia do we have the patient under such perfect control as with closed ether vapor. Ether waste is entirely eliminated. The amount of ether consumed in my series averaged 2½ ounces per hour.

The apparatus employed for the administration consists of an electric motor and blower, the Gwathmey three bottle apparatus, and an inhaler which has the rebreathing bag close to the patient's mouth. The technic is that described by Gwathmey. The water bottle of the ether container is filled with two ounces of water to which are added one to two drams of a 25 per cent. essence of orange. About one ounce of ether is placed in the small chloroform bottle. Four ounces of ether are placed in the ether bottle. The bag is now filled with air pumped through the water bottle which contains the essence of orange. The mask

is placed upon the patient's face and the patient breathes back and forth into the bag. The motor is started and sufficient air is pumped to keep the bag over 2/3 full at all times. The index is gradually turned towards the ether contained in the chloroform bottle. The patient is now getting a very small amount of ether which is apparently imperceptible. Should coughing, holding the breath or struggling occur, the ether is turned off again. The addition of ether should be very gradual. The index is now again gradually turned back to the ether contained in the chloroform bottle and slowly increased until the index reaches full ether of the chloroform bottle. The patient will now be found to be in a state of full surgical anesthesia, the average time required to reach this stage being six minutes. When this is accomplished the index is turned back to air again and gradually turned towards the ether bottle. Anesthesia is maintained with the index turned about a half inch from air, between air and ether, the percentage being regulated according to the patient's condition. The expiratory valve is at all times slightly open. The bag remains moderately distended, a slight positive pressure being a decided advantage. The breathing with this form of anesthesia is quiet and regular. The mucus rale and snore are absent. Salivary and mucus secretion is greatly diminished or absent altogether. An artificial airway was seldom found necessary. The lid reflex is absent, the eyeballs are rolling, but the patient is sufficiently relaxed for all surgical operations. Relaxation is obtained in a much shorter period, particularly in difficult upper abdominal procedures than with any other method in my experience. The pulse is nearly normal and the patient's color is always pink. A purplish tinge or cyanosis is never present. The conditions contrast strongly with those often seen under the older methods of closed ether administration. Return to consciousness is rapid and characterized by diminished nausea or vomiting. Over seventy per cent. of my cases had no post operative vomiting. There were no cases of protracted vomiting. After being returned to bed they rest quietly for a few hours and then awake as if from a natural sleep.

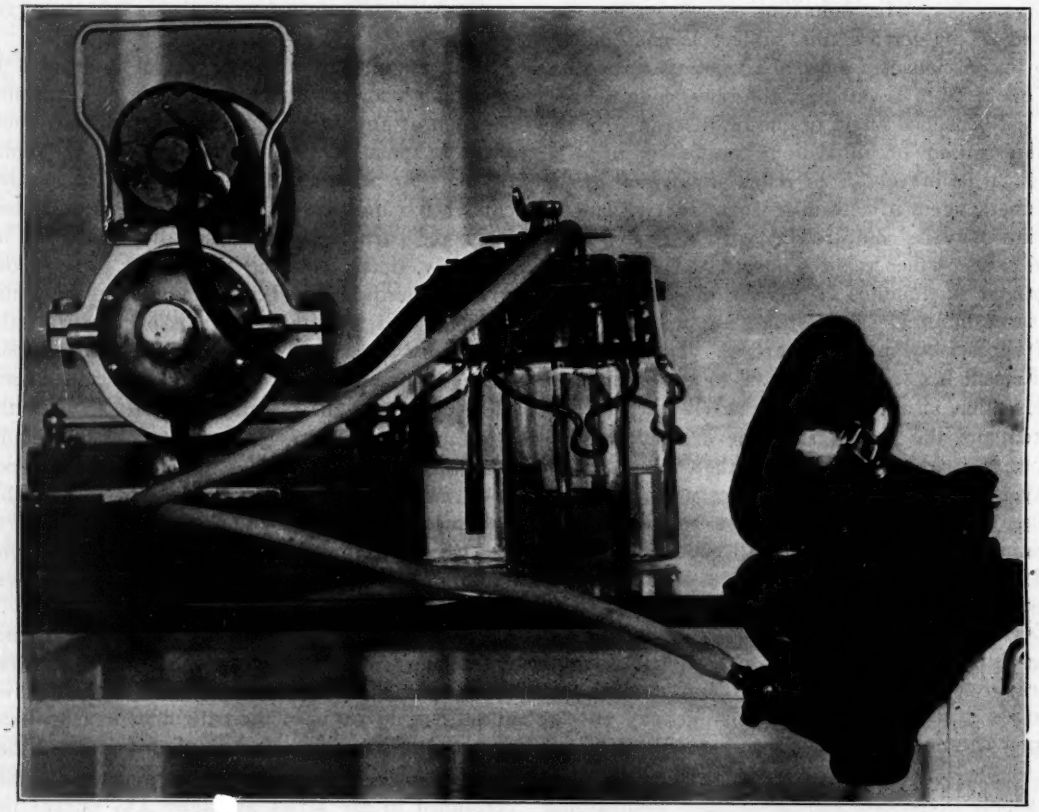

Fig. 1. Author's Apparatus for Essence of Orange-Ether Vapor Sequence.

To summarize, the method approaches the ideal anesthesia more closely because of the following factors:

1. Rapid, pleasant induction devoid of excitement.
2. An even maintenance under constant control with perfect relaxation.
3. Air supply sufficient for propor oxygenation with continuous partial rebreathing.
4. Prompt and uneventful recovery.

259 BROOKLYN AVE.

ABSTRACT OF DISCUSSION.

DR. RAY A. RICE, Columbus, Ohio: I want to get up right away and discuss this paper. Dr. Kruskal's idea concerning the closed ether method certainly meets with my approval. I have given anesthetics in all ways, and with almost all manner of apparatus. In my opinion, the open method is very inferior. I used it for several years and found that too much of the vapor was wasted, and that I got too much of it myself. During the past year, I have used what is practically an entirely closed method in continuing my anesthetics. However, I do not start my anesthetics in the way that Dr. Kruskal does. I have a semi-closed inhaler drop method of my own that I use to get my patients to sleep; but when I get them on the table in the operating-room and they are well relaxed, I switch to an entirely closed method, which is different from Dr. Kruskal's in that I vaporize my ether by passing oxygen through it. In this way, I get a pure oxygen-ether vapor. It is entirely a rebreathing method. I use Coburn's metal breathing tube and have, in addition to that, a bag; and a connecting apparatus with a tube runs from Gwathmey's three-bottle vaporizer, which I have used for several years in nose-and-throat work. A low-pressure oxygen tank is used to vaporize the ether; and I have a piece of rubber around the tube that fits between the lips and the gums. The patient gets no outside air at all, the nasal passages being stopped up. This gives me the most perfect anesthesia that I have ever seen. The patient has to be entirely relaxed before the breathing tube is inserted. There is sometimes a coughing and strangling sensation, which the patient does not know about, of course. I have used this method for a year or over, with entire satisfaction. I think that the rebreathing method stimulates respiration and heart action and prevents shock. I seldom see a patient in a cold, clammy perspiration such as you see in shock; so it must be the ether-oxygen anesthesia that is stimulating and prevents that trouble. Of course, my patients all have a preliminary hypodermic of scopolamin and morphin, with an additional 1/150 of atropin. They never have mucus in the throat. I never have to hold up the jaw any more, because the tube passes in beyond the root of the tongue and holds it up.

DR. ISABELLA HERB, Chicago: I, too, want to get up at once to say that I disagree with Dr. Kruskal as much as Dr. Rice agrees. Dr. Kruskal gives his average length of induction as six minutes. I give seven minutes as mine. With the open-method my patients never have coughing or strangling, because I give plenty of air in the beginning, which does not lengthen the time required for giving the anesthetic. If you employ a concentrated vapor the patient will hold his breath.

So far as the cold vapor is concerned, I should like to speak of this; but, as Dr. Davis is to read a paper on it later, I will pass this by. In regard to regulating the dose, I would say that you must give enough to keep the patient asleep. The operation will regulate that. Of course, the different structures of the body have different degrees of sensitiveness; and if the anesthetist keeps in touch with the surgeon, he will know at what stages of the procedure the patient must be kept more soundly asleep than at others. He must vary the depth of the anesthesia according to the requirements of the operation. The patient should not be kept too dead asleep or too lightly anesthetized, but must be kept quiet at all times.

Nausea and vomiting, we might say, are things of the past. With the open-method we have very little. The patient may vomit just before awakening; but, as a rule, not very much. We do not average more than fifteen per cent. of cases of vomiting with the open-method. Abdominal tension, I have certainly noticed after the open method; but so far as shock is concerned, I have never seen this produced by an anesthetic. When I have seen it, it has been due to hemorrhage, to the operative procedure, or to too profound a degree of anesthesia. I think that the latter statement I should really modify. If the patient dies, it is not from shock, really, but from paralysis. When one uses the word shock, one should also describe the condition. I believe that you cannot produce shock with the anesthetic, but that it arises from other factors that enter into the procedure. Not long ago, another physician noted what I have noticed many times, and that is the rapid breathing that accompanies the rebreathing method. He counted forty-six or forty-eight breaths to the minute. You never see that in the open method of etherization. If you have used proper technic, the patients breathe naturally. So far as patients' leaving the table in the condition that Henderson described as acapnia, I do not think that this is due to the anesthetic agent. I have not seen a condition such as he has described due to the ether. If the anesthetist piles the ether in and has it dripping off the mask, it is not the fault of the method, but of the anesthetist. We do not have excitement, except in alcoholics; but you have that, regardless of the method that is employed. That stage soon passes off, however.

Dr. Rice spoke of absolute rebreathing and said that he uses oxygen vapor, passing it through the ether; and said that he never gives his patients outside air. No, of course not; because it is the oxygen of the outside air that it required, and his patients are getting all the oxygen they need.

DR. CHARLES K. TETER, Cleveland: I have enjoyed this paper very much. It again brings to the attention of anesthetists the fact that we are all learning and the general profession is learning that the success of anesthesia depends more on the skill of the anesthetist than on the method that he may use. In the closed method of ether anesthesia, as Dr. Kruskal has explained, we undoubtedly have a very excellent method indeed. He uses atmospheric air in place of oxygen, and Dr. Rice goes to the other extreme of using no atmospheric air; so we have both extremes. I halt between the two extremes. Instead of using the nitrogen in the air, I use the oxygen and a small amount of nitrous oxid; and I find that I obtain better results than from just using the oxygen passed through ether. It prevents an over percentage of carbon dioxid in the rebreathing mixture. I have had more satisfactory anesthesia and better results since I have been using this combination than I had before. I think that most of the technic we are using are good, and that it is merely a matter of perfection of technic in the method that we select. The point of the whole thing is accuracy and constancy of the dosage. When you have the proper depth of anesthesia established, you should then use only enough of the anesthetic to maintain this. The thing that we are all striving for is to obtain the best result.

DR. L. SEALE HOLMER, London, Ontario: I should like to ask whether Dr. Kruskal uses preliminary medication, and what lung complications he has with this method in comparison with the open drop method—that is, whether these are exaggerated in his method or not?

DR. W. M. BOOTHBY, Boston: There is just one pharmacological question, brought up by Dr. Herb, that I should like to speak of. She said that you cannot produce shock with ether. Of course, she does not do so, because she does not carry her patients to that depth of anesthesia. The only thing that I wish to bring out is that if you employ a higher ether tension, this will occur. In rabbits, you can maintain normal blood pressure when you use 42 mm. of ether tension; but if you run up to 50 mm., the blood pressure falls and the animals die through the action of the drug. Of course, Dr. Herb has never seen this occur. However, I think that it is a mistake to let the teaching go out that ether will not produce lowering of the blood pressure; and I have taken it that there is

a corresponding diminution of blood pressure in clinical cases. You can put the patient into a definite surgical shock by this means. Of course, you are not to push the anesthetic too far. The result is due to a too high strung development of tension in the body.

DR. HARPER: The word shock has been used a great many times. I think that the word collapse would be better. The latter word should be used when describing the effect of a too profound anesthesia. Shock is due to post-operative hemorrhage, and this word should not be used in connection with anesthesia by itself.

DR. J. T. GWATHMEY, New York City: I enjoyed this paper, because it introduced a practically new method of giving ether; and it is one of the best methods, it seems to me. I do not think, however, that any of us now know which is the better, the open or the closed method. I have used both without producing shock.

The question comes up of a comparison between this method and the gas-ether sequence, the gas-oxygen-ether and the drop method. I look upon the gas-ether sequence and the drop method as two pioneer methods that should be methods of the past. Occasionally we have a death in the first two or three minutes, because no oxygen is used, in the former; and the drop method should also be a thing of the past, because it does not matter how accurate you may be, you cannot approach in accuracy that of a mechanically driven air supply. I think that Dr. Herb, for instance, would get better results if she would try one of these methods, either the open or the closed, comparing the results with those she now gets. It is not a comparison between the anesthetics, but between the methods of administering them. Dr. Kruskal has used the drop method and has finally evolved this method that he now employs. If what Dr. Herb says is true, that we must have struggling with alcoholics, then this method is superior to the drop method; because we do not have it with Dr. Kruskal's method. I have never seen a patient struggle under this method.

All my patients have preliminary medication. In regard to the amount of ether, two ounces and a half in an hour's administration, when absolute relaxation is obtained, cannot be approached by the drop method; and the results are beyond anything that can be produced by the drop method.

DR. NAGLE, Montreal Canada: This method appealed to us so strongly in Montreal that in our new surgical pavilion we have a compressed-air plant; so that the anesthetic can be mixed before it reaches the patient, and more or less accuracy of dosage is obtainable. I have tried to get it absolutely accurate. I think that the success of Dr. Kruskal and Dr. Rice all depends on getting the anesthetic well mixed before reaching the patient.

DR. W. D. GATCH, Indianapolis, Ind.: Do you use a positive intra-pulmonary pressure?

DR. KRUSKAL: The bag is two-thirds distended, so there must be a positive pressure of eight or ten millimeters. The bag is nearly always distended.

DR. BOOTHBY: It cannot be so much as that.

DR. E. I. MCKESSON, Toledo, Ohio: With a rubber bag two-thirds distended, the pressure will not run over three-millimeters of water. I have been making some experiments along this line.

DR. M. P. DENTON, New York City: I think that five millimeters would be the approximate amount of tension.

DR. TETER: I have been working with positive gas-oxygen anesthesia for many years, and taking the pressure; and I have found that with the bag a considerable distance from the patient and with a positive pressure of five millimeters in the bag, there was a negative pressure during inhalation. Therefore, I now take the bag up directly to the inhaler. With a large opening and with four millimeters of pressure in the bag, the inhalation pressure is 2¼ mm.

DR. F. L. RICHARDSON, Boston: I think that at the end of two years, when all this information is boiled down, you will not be using either the open or the closed method. In certain cases, we shall use a closed method; and in others, an open method. There are certain cases in which I think that the patients would be benefited by the use of the closed method; and in these cases, I change to it. I think that the time is coming when we shall not stick to any one method, but shall select the one adapted to the particular case.

DR. KRUSKAL (Closing): I do not believe that I can answer all the questions. With reference to the induction, it was not always done with the closed orange-ether. We can induce anesthesia with gas-oxygen. I have done that repeatedly. You can do that, and then change to ether vapor.

With reference to using oxygen instead of air, I do not see any particular advantage in it. except in grave surgical risks. In reference to premedication, I would say that in all cases I gave morphin and atropin, but never scopolamin, unless contraindicated. A few patients had doses of chloral and potassium bromide by rectum an hour beforehand. In two robust individuals, I found a dose of this of decided advantage.

Dr. Gwathmey has answered Dr. Herb so very well that there is nothing left for me to say. The reason I use closed ether is because it has a decided advantage over open or semi-open. I would not go back to any method except a vapor method of ether administration. I think that there is a decided advantage in furnishing definite quantities of ether mixed with air directly to the patient.

Now, in regard to the question about pulmonary complications, I would say that these were difficult to follow in this series, in which a great many cases were acute surgical conditions. In this record, there were 45 gall-bladder cases and acute kidney conditions. It is necessary to assume that pulmonary infarcts and emboli occur in these conditions, and I could not tell whether they were purely post-operative pneumonias or the result of the operation. I am now working on the problem of determining which are postoperative and which are not.

In closing, I would say that I realize that open and semi-open ether can be given with satisfaction; and most of us could, in a simple, ordinary fifteen-minutes procedure, get as good results with them. The operations that I refer to, however, are those lasting for a long time, where profound relaxation is required, and involving a great deal of operative surgical shock. I have limited the cases in this paper to grave surgical conditions.

NITROUS OXID-OXYGEN ANALGESIA IN OBSTETRICS.*

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The conduct of labor among our primeval ancestors was purely intuitive. In difficult cases the older women of the tribe would assist with pressure, massage and nauseating drinks. With the earlier forms of civilization some of the older women assisted during labor and the priests gave spiritual or mechanical assistance in difficult cases. From the time of Hippocrates 400 B. C. to 1550 A. D. the practice of obstetrics among the civilized races remained practically the same. Normal labor was wholly in the hands of women who may be termed practical midwives, and medical men were called only in cases of dystocia. There was a total ignorance of anatomy and physiology; the cephalic presentation was the only natural or hopeful one; labor was supposed to be a voluntary act on the part of the child and unless it came naturally its

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life was utterly disregarded and the barber surgeon was called to remove it with destructive instruments.

But with the anatomica description of the human pelvis by Vesalius in 1543 and the delivery of a live child with podolic version by Paré in 1550 the scientific investigations which have resulted in our present obstetrical knowledge were started. Louise Bourgeous published the first *Midwifery* in 1600 or twenty-eight years before Harvey discovered the circulation of the blood. Rousset performed a Cæsarean section in Paris in 1581 while the straight forceps of Chamberlaine were not introduced until 1668. Obstetrics was first recognized as an important branch of medicine in 1720 when Gregoire established the first obstetrical chair in the Hôtel Dieu in Paris (Engelman).

The development of the science of obstetrics has been extremely slow. There has been more progress during the past seventy years than during all the preceeding centuries. Nearly three hundred years after Paré did his first podolic version our own Oliver Wendell Holmes called attention to the cause of childbed fever, and the teachings of Semmelweiss and others prepared the way for the development of modern scientific methods in obstetrics. That childbirth is still the most dangerous event in the life of the average woman is not due to lack of scientific knowledge regarding this most important function of woman, but rather to the stupidity of man, who is instinctively penny wise and pound foolish. There is abundant proof that scientific obstetrics does remove most of the dangers associated with the bearing of children, yet, due to the continued practices of ignorant and unclean midwives, both male and female, the average mortality from childbirth is as great today as before the discovery of anesthetics and antiseptics.

"The ancients fully appreciated the increased susceptibility of the nervous system of women during pregnancy and in the puerperium; the law in Carthage and in Athens forbade the pursuit and punishment of a criminal or murderer who sought refuge in the home of a woman who was pregnant or had recently given birth to a child" (Englemann). Yet very little attention was given to the relief of pain during labor until the time of Sir James Y. Simpson. For seventy years our best obstetricians have endeavored to mitigate the pangs of labor, using whatever analgesic seemed best suited to the individual case.

Within the past two years without an apparent thought for safety many lay writers and a few physicians have created an almost hysterical demand for painless obstetrics. The present hysteria may be made productive of much good, if we as physicians will show our patients the obvious need of better obstetrics. When the average citizen learns that a human life has a real value in dollars and cents, possibly the politicians who rule us may give our women and children a few hundred thousand dollars after they have spent our millions for cattle and hogs. May God hasten the day when human life and suffering are placed at least on par with commercial enterprises!

Seven years before Robert Fulton built the first successful steamboat, Sir Humphrey Davy discovered the anesthetic properties of nitrous-oxid. However, it was used only in amusing laboratory experiments until Horace Wells inhaled it during a tooth extraction in 1844, and after that it was little used until after Edmund Andrews and Paul Bért, working independently, showed that its dangers were due to the lack of oxygen. Working in the early eighties with an extremely crude apparatus, Klikowitsch and Winckel showed the value of nitrous oxid-oxygen analgesia in normal labor. That its use has been revived is only natural, and, considering the many objections to other anesthetizing agents, we wonder why the remarkable results reported by these two scientists were ignored so long.

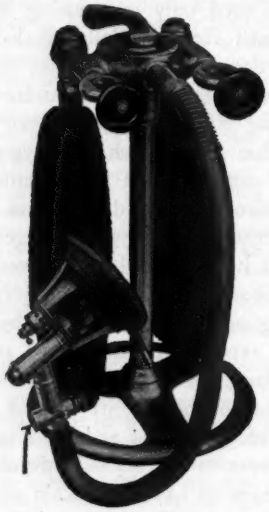
Limitations in the use of opiates during labor have been recognized for at least a century. William P. Dewees in the second edition of an essay on "The Means of Lessening Pain and Facilitating Certain Cases of Difficult Parturition," published in 1819 by Thomas Dobson & Son, Philadelphia, says: "I have in a number of instances seen opium exhibited with a view to mitigate the severity of the pain, when labor advanced slowly, and have never failed to observe that the force of the contraction was diminished at the time it was required to be the strongest."

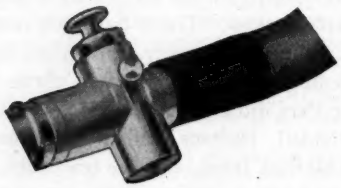
Chloroform and ether have been used since 1847, and certainly have proved a blessing to thousands of women. Chloroform, because of its greater toxicity, is gradually being discarded in America. Great public interest has been aroused in the morphin-scopolamin treatment because of its exploitation in the lay press; but following a temporary burst of enthusiasm by a few medical writers, its known limitations are leading to its general disuse except as a preliminary measure in a small percentage of cases. From an extended and careful study of analgesia and anesthesia in labor, I believe that, in order of safety, nitrous oxid-oxygen is first, ether second, chloroform third, and morphin-scopolamin fourth.

In the recent attempt to justify the use of chloro-

form during normal labor, Hill argued that the body changes found to occur when chloroform is used experimentally were due largely to the element of shock arising out of the animal's fear. If his argument were sound the same changes would occur regardless of the anesthetic employed, since the element of fear is constant. The experiments of Woodyatt and Graham indicate that such is not the fact, since they found that these changes are much less marked when ether is used and are practically absent in animals to whom nitrous oxid was administered for a much longer time.

Since it is generally agreed that, when properly





Figures 1, 2. The A. C. Clark Apparatus in use by the author for nitrous oxid-oxygen anesthesia and analgesia in obstetrics. (2) The trigger-valve for the self-administration method.

employed nitrous oxid and oxygen is the safest of anesthetizing agents, and that, when given to the stage of analgesia, death from its use is inconceivable, the only objections to its administration during labor must arise from its cost and the difficulty of administration. Unfortunately nitrous oxid and oxygen does cost considerably more than ether or chloroform; and, while its wider use will result in a reduction from present prices, nevertheless the greater difficulty of storing and distributing will keep the cost well above that of ether and chloroform. As I have stated in other papers, the average cost per case for the gas has not exceeded five dollars, although in a few instances it has cost as much as ten dollars. The administration of the analgesia was, in our earlier work, very time consuming and tiresome, but with the simple technic which I instituted last year the patient who has the nitrous oxid-oxygen analgesia during labor requires no more careful watching than the patient who has ether, chloroform, or no anesthetic. So far as I can determine, there are no contraindications to the employment of the nitrous oxid-oxygen analgesia other than the practitioners' ignorance regarding the science of obstetrics and the administration of this agent. Any physician capable of giving proper obstetrical care can, in a comparatively short time, master the technic for administering the nitrous oxid-oxygen analgesia during normal labor. A special anesthetist is not needed except in the abnormal case where some operative procedure becomes necessary. During the earlier part of labor the patient can administer her own analgesia, and, when bearing down efforts are desired, an interne, the nurse or some other member of the family can hold the inhaler over the patient's face and release the gas when the uterine contraction begins.

TECHNIC FOR ADMINISTERING NITROUS OXID-OXYGEN ANALGESIA

Preparation of Patient: The patient is prepared as for any normal labor. There is no objection to her taking such food and drink as she may desire, provided it is given in small amounts. A woman in labor is doing hard work and requires nourishment.

Time for Beginning Analgesia: Our patients are told that the analgesia will be started whenever they desire it. But we explain that early in labor they will have merely cramps and that so long as they are not severe there is no need to use the gas. It is rare that a patient will need the analgesia until near the end of the first stage and many feel very little pain until the second stage of labor is well advanced.

Posture of Patient: The patient's comfort is of primary consideration. Early in labor she may assume a sitting or semi-reclining posture, but when the head comes down on the perineum she should be placed in the position desired for delivery. Usually our patients are delivered in the dorsal position.

Apparatus: There are several good nitrous oxid-oxygen machines on the market and any one may

be used to administer the analgesia. The obstetrician must, however, be familiar with the mechanism of his appartus, and the machine, which requires little manipulating, enables him to give more attention to the patient. A free, easy passage of the gases is necessary. All valves must be working easily and perfectly. The apparatus should have two bags, one for nitrous oxid and one for oxygen, or some other means of sight feed which will show that both gases are available at all times. Machines which have automatic pressure regulating devices should have also other connections which will allow a direct passage from the cylinders to the bags, since any delicately adjusted mechanism may at times fail to work properly. Care must be taken to prevent a leakage of the gas from the tops of cylinders and connections about the apparatus. A little leak is one of the greatest sources of unnecessary expense and may, in course of a few hours, prove very costly.

In hospital practice the large cylinders should reduce the cost of the analgesia. But for the home the small cylinders are more satisfactory.

We use a nitrous oxid-oxygen apparatus equipped with automatic regulating devices based on the general principal of the automatic water regulators in toilets. These allow gases to flow from the cylinder only as the patient inhales the gases and thereby reduces the pressure in the bags. With these regulators it is possible to maintain the desired *low* pressure in the bags during either intermittent or continuous administration.

When I first tried self-administration, I used an old inhaler with a slide shut-off valve in its intake, but as this was rather unhandy the manufacturers have constructed an automatic feed which may be inserted in the gas line next to the inhaler. Using this apparatus with automatic regulators and automatic feed, a patient requires no more careful watching than the patient who has no analgesic. The regulators are set so that when the gases are turned on, the bags will remain about one-third distended. The valve in the mixing head is set so that the mixture will contain about five per cent. oxygen. Using the small portable model of the same apparatus, which does not have the regulating devices, it is necessary for some one to replenish the gases during the interval between contractions.

Administration: As soon as the patient desires the analgesia, the gases are turned on; the apparatus is placed to the right side of the delivery bed; the patient is asked to hold the inhaler by placing her thumb on the slide valve of the automatic feed and the fingers over the upper portion. During an interval between contractions she is asked to place the inhaler over her face, press up the valve with her thumb, and to take five or six slow, deep inhalations of the gas so that she may experience the sensations of analgesia. She is then told that she shall place the inhaler over her face and breathe in the same manner when she feels the first suggestion of the next contraction. When she has counted four, five or six inhalations, according to the number required to secure relief from the pain, she releases her thumb and breathes air through the inhaler which is kept over the face until the end of the contraction. Should she at any time feel a little pain she can take another inhalation by the simple pushing up with her thumb. It is rare that a patient will not follow instructions and breathe enough gas to lose consciousness, but even then she can do no harm, since her thumb will relax and the valve close automatically. The breathing of air will quickly restore normal consciousness.

A number of my patients have administered their own analgesia for more than five hours. They find this a rather delightful diversion during the long hours of ***wakeful working,*** and some are reluctant to give up the inhaler when strong bearing down efforts are desired near the end of labor.

Types of Patients: Winckel in his early work observed the difficulty in administering a nitrous oxid-oxygen analgesia to women of low mentality. Large women of the masculine type and those suffering from obesity usually require a large amount of gas. Hysterical women usually cause some trouble, especially when the gas is started late in labor. Primiparae cause more trouble than do multiparae. Some women have very irritable uteri and the painful stage of the contraction is reached so quickly that with the usual method of administering the gas no relief is secured. But by varying the technic to suit the individual case, and occasionally administering a continuous analgesia I have been able to secure satisfactory results in all classes of patients.

VALUE OF NITROUS OXID-OXYGEN ANALGESIA

From our experience we believe that nitrous oxid-oxygen analgesia is the most satisfactory and safest method which has yet been employed to relieve the suffering labor. It may with minor variations in technic be used successfully in every case which requires an analgesic during the painful stage of labor. However, for the discomfort which accompanies a prolonged first stage with little or no dilatation of the cervix, chloral hydrate, heroin hydrochlorid, or morphin-scopolamin treatment is usually indicated. Nitrous oxid and oxygen cannot prevent dystocia from a disproportion or a mal-presentation, but it does lessen the dangers from maternal exhaustion without an increased risk to the child. We have found the second stage of labor somewhat shortened because of better cooperation on the part of the mother. There is less surgical shock and as a rule the patients make a smoother recovery. The babies show no increased evidence of asphyxia and cry as quickly as do those, whose mothers have no analgesic.

Nitrous oxid and oxygen has been widely used for a number of years and its safety as an anesthetic is generally recognized. Within the past two years the analgesia has been used by scores of physicians and in hundreds of confinements, yet no physician who has used it long enough to develop a satisfactory technic has failed to recognize its value in obstetrics. The use of the nitrous oxid-oxygen analgesia cannot take the place of clean, scientific obstetrics, but it does relieve the agony of labor and it should prove a blessing to thousands of women.

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OCTOBER EDITORIALS. 1916

INSTRUCTION OF MEDICAL STUDENTS AND HOSPITAL INTERNES IN ANESTHESIA.

In his Presidential Address before the Fourth Annual Meeting of the American Association of Anesthetists at Detroit, June 12, Dr. Willis Drew Gatch, Professor of Surgery in the University of Indiana Medical Department, presented much food for thought. Unlike most critics, Dr. Gatch has the courage to present a plan for constructive reform. This plan dovetails into the routine courses of the curricula of all medical schools and can be readily adapted to the purposes it is meant to serve. Dr. Gatch has gone even further and personally introduced the excellent procedure into hospital routine of having a trained anesthetist responsible for the preliminary examination and preparation of the patient for the operative ordeal and the patient's immediate post-operative care. Thus the specialist in anesthesia assumes his proper role as a vital factor in the surgical team. Also the specialist in anesthesia becomes the supervisor of the department of anesthesia in the hospital and the clinical instructor of the internes in the anesthetic service.

Dr. Gatch's plan (herewith presented in the SUPPLEMENT) is a credit to him, since it conserves all the rights and privileges accorded the licensed anesthetist under the Medical Practice Acts of the various States, and yet solves some of the difficult problems that present in the instruction of medical students and hospital internes in anesthesia. It is to be hoped that the committee appointed by the American Association of Anesthetists to handle this matter, and indorsed by the Interstate Association of Anesthetists, will be able to put Dr. Gatch's plan into routine use in the medical schools and hospitals of the country as rapidly as possible.

F. H. M.

THE OHIO STATE MEDICAL BOARD AND THE NURSE-ANESTHETIST.

At the recent meeting of the Interstate Association of Anesthetists in Louisville, Ky., July 26, the following motion was adopted unanimously:

"That the Association, through its officers, the official journal and its individual members, bring to a definite end the administration of anesthetics by unlicensed persons in every State of the Middle West in which such an action can be secured."

In consonance with this determination, a petition in this respect, signed by prominent physicians, surgeons and anesthetists throughout Ohio, was presented to the Ohio State Board and at its meeting, August 9, the Board adopted the following resolution:

"WHEREAS *it has been charged in a petition, signed by many well-known and reputable physicians, that the law regarding the administration of anesthetics by others than licensed physicians, has been systematically violated by the Lakeside Hospital, Cleveland, Ohio, and that courses in anesthesia are given nurses in Lakeside Hospital for the purpose of and with the intent to violate the above-mentioned law.*

"BE IT RESOLVED, *That until these charges are disproven and such courses, if given, discontinued, that all recognition of the Lakeside Hospital as an acceptable training school be withheld and recognition of its graduates as registered nurses be denied.*"

If this action on the part of the Ohio State Medical Board to abolish the nurse-anesthetist abuse, does not suffice, the Interstate Association will present evidence to the Board warranting prosecution under the law.

It has been announced that the authorities of Lakeside Hospital, backed by the Cleveland Hospital Council and the Ohio Hospital Association, have requested a hearing before the Board and this will be held in Columbus October 2, at which time all the parties interested will appear for a discussion of the nurse-anesthetist abuse. Unless the Board continues to sustain the licensed anesthetists, the matter will be taken into the Ohio State Medical Association for adjustment.

F. H. M.

Book Reviews

A carefully selected library is essential to a thorough knowledge of the science and practice of a specialty.

Practical Medicine Series: General Surgery (Volume II). Edited by John B. Murphy, A.M., M.D., LL.D., F.R.C.S., England (Hon.), F.A.C.S.; Professor of Surgery in the Northwestern University; Attending Surgeon and Chief of Staff of Mercy Hospital and Columbus Hospital; Consulting Surgeon to Cook County Hospital and Alexian Brothers Hospital, Chicago. Series 1916, cloth, 620 pp., illustrated. The Year Book Publishers, Chicago, 1916. Price, $2.00.

This volume of the Practical Medicine Series as usual includes a brief review of many advances in anesthesia and analgesia. Wiltsie discusses the question *whether the anesthetist is sufficiently trained as a surgical assistant.* He concludes that a decision must be arrived at as to whether licensed physicians or nurses shall monopolize the administration of anesthetics, and then that whichever experts are selected, sufficient training should be given to make them proficient. Henderson and Bryant are quoted on their recent researches in acapnia and apnea as influenced by open, semi-open and closed methods of etherization, the Rovsing mask and technic being explained in detail. The newer apparatus of Layton for vapor anesthesia, of Sutcliffe for the drop method, the modification of the Ferguson inhaler by Wolfson, the improved inflatable cushion of Coburn for nitrous oxid, and the improved pharyngeal tubes of Lumbard and Pinneo are described and illustrated.

Brenizer's scopolamin-morphin-cocain technic of anoci-association is given in detail, and considerable space is also devoted to Harris' researches on nerve-blocking and the value of calcium chlorid in prolonging the obtunding effect of local analgesics. The experiences of Boit with brachial plexus anesthesia and those of Bull with extradural anesthesia are recounted. Bevan's studies in the choice and technic of the anesthetic are included, as well as the pertinent clinical conclusions of Dagg on anesthetic risks. Lumbard and Lathrop's technic for ether-oil colonic anesthesia in thyroidectomy are indicated and their results corroborated.

Throughout the volume, whenever possible, the anesthetic technic is connected with certain surgical procedures. It is of interest also that the experiments and clinical results of Waterhouse with the therapeutic use of ether in acute infections is given due prominence. This use of ether promises to be one of the outstanding advances in the control of infections and to question the dictum that etherization destroys immunity.

The After-Treatment of Operations. By P. Lockhart-Mummery, F.R.C.S. (Eng.), Senior Surgeon to St. Mark's Hospital for Cancer and the Queen's Hospital for Children, London. Duodecimo, cloth, 275 pages, illustrated. *Fourth Edition.* William Wood & Co., Publishers, New York, 1916.

While Mummery's book was originally written for practitioners and house-surgeons, it is equally as valuable to the specialist in anesthesia. The day has passed when the anesthetist's work begins and ends in the operating-room. The anesthetist is rapidly becoming that member of the surgical team who is responsible for the proper preparation of the patient for the operative ordeal and for such postoperative care as will insure an uneventful recovery.

The continued popularity of Mummery's manual and the call for a *fourth edition* show that it has proved of real value to those readers for whom it was designed. In the present edition much new matter has been added and the entire context brought up to date. In particular the chapter on Surgical Shock has been entirely rewritten in the light of more recent work on this subject.

While the routine methods of after-treatment are given especial emphasis is laid on those practical details which anticipate the incidence of untoward complications.

The Internal Anatomy of the Face. By N. H. Cryer, M.D., D.D.S., Professor of Oral Surgery, University of Pennsylvania; Oral Surgeon to the Philadelphia General Hospital. *Second Edition,* Revised and Enlarged. Cloth, octavo, 360 pages and 377 engravings. Lea & Febiger, Publishers, Philadelphia and New York, 1916. Price $4.00.

Surgeons and dentists who wish to perform successful operative procedures under local or conductive anesthesia, must be skillful anatomists. Now anatomy cannot be classed among the exact sciences. The more closely the subject is studied the more variations as to details are discovered. Especially is this true of the anatomy of the human head, as it is modified by climate, race, age, disease, occupation and many other conditions.

In his book, Cryer has given the results of years of special study of the anatomy of the head and face. In pursuance of his research hundreds of sections of the facial region have been cut and examined. The lesson they teach is that the accepted descriptions are to be received as only general truths and that they cannot be depended upon or followed literally as a guide for the surgeon or dentist.

Cryer's investigations afford a basis for the explanation of the failure of many dental and surgical operations conducted along the lines of accepted anatomical description; such failures have been regarded as merely the natural percentage of unsuccessful treatment, whereas, they have probably been due to variations in the parts clearly within the limits of normality. This is thoroughly demonstrated in the present work by text and illustration.

To those surgeons and dentists who wish to improve their anatomical intuition and thereby also facilitate their technic of local and conductive anesthesia and the details of their operative procedures on the face and head, this volume of Cryer will satisfactorily answer their needs. In text and illustration the book leaves nothing to be desired. In view of the artistry of the frontispiece, the reviewer raises the question as to whether medical works as a whole should not be printed on India tint paper.

Society Proceedings

Membership in a society devoted to your specialty is an essential to success.

INTERSTATE ASSOCIATION OF ANESTHETISTS.

The Second Annual Meeting of the Interstate Association of Anesthetists was held in Louisville, Ky., July 26, 27, in conjunction with the National Dental Association. It was a success not only in point of attendance, but also in the interest and quality of the papers presented. As these papers will be published in the Supplement there is no occasion to review them now. The Joint-Session at the Gaiety Theatre with the N. D. A., in which a symposium on Anesthesia for Oral Surgery was presented, created a very favorable impression on the members of the allied professions in attendance, especially as a number of the papers were illustrated with moving picture films. These demonstrations enabled the large audience to appreciate all the details of technic as well as if each individual had been standing at the clinician's elbow.

During the Executive session the following officers were elected for the ensuing year: Chairman, Isabella C. Herb, M.D., Chicago; Vice-Chairman, E. I. McKesson, M.D., Toledo, O.; Secretary-Treasurer, F. H. McMechan, M.D., Avon Lake, O.; Executive Committee, T. J. Collier, M.D., Atlanta, Ga.; F. W. Rounds, D.D.S., Louisville, Ky.; Hugh Barr, M.D., Nashville, Tenn.; J. R. McCurdy, M.D., Pittsburgh, Pa.; Lillian Mueller, M.D., Indianapolis, Ind., and O. E. Lanphear, D.D.S., Kalamazoo, Mich. The next place of meeting was left to the discretion of the Executive Committee. It was unanimously resolved that the Association through its officers, its official journal and its individual members bring to a definite conclusion the administration of anesthetics by unlicensed persons in every state in

the Middle West in which such action can be secured. It was also decided to co-operate with the Committee appointed by the American Association of Anesthetists at the Detroit Meeting to investigate and improve the methods of teaching anesthesia and of providing improved anesthetic service in hospitals and clinics. The Secretary was also empowered to investigate anesthetists' fees under the Workmen's Compensation Acts in various states and initiate action to standardize these fees and make them commensurate with the services rendered. In a discussion of the Association's welfare it was determined to add clinical and research demonstrations to future programs of the annual meetings.

The following members were admitted to membership: Drs. H. W. Barton, Akron, O.;; W. L. Shearer, Omaha, Neb.; Benj. Landy, Minneapolis, Minn.; J. P. Henahan, Cleveland, O.; John R. Worley, Dallas, Tex.; F. F. Molt, Chicago, Ill.; E. Klaus, Cleveland, O.; Mary E. Hopkins, Louisville, Ky.; R. E. Holder, Columbus, Ind.; J. W. Heim, Louisville, Ky.; P. J. Federspiel, Racine, Wis.; Arthur E. Smith, Chicago, Ill.; Louis H. Maxson, Seattle, Wash.; S. L. Silvermann, Atlanta, Ga.; Robt. R. Bosworth, Chicago, Ill.; A. Brom Allen, Chicago, Ill.; E. L. Brady, Marion, O.; Wm. H. DeFord and Jessie Ritchey DeFord, Des Moines, Iowa; Harry M. Fisher, St. Louis, Mo.; Val. H. Frederick, St. Louis, Mo.; F. L. Gruber, Columbus, O.; G. B. Winter, St. Louis, Mo.; F. C. Vandervort, Bloomington, Ill.; Emil Specht, Brooklyn, N. Y.; F. W. Rounds, Louisville, Ky.; B. Merrill Ricketts, Cincinnati, O.; Edward Remy, Jr., Mansfield, O.; Roy S. Hopkinson, Milwaukee, Wis.; Samuel Johnston, Toronto, Can.; Otto U. King, Huntington, Ind.; E. L. Moravec, Cedar Rapids, Iowa; K. R. Ruddell and L. Lockerie, Indianapolis, Ind.

The Association dinner, served in the Leather Room of the Hotel Seelbach, was a very enjoyable affair and was graced by the presence of Mrs. Taylor of Athens, Ga., one of the surviving daughters of the discoverer of etherization, Dr. Crawford W. Long, about whose discovery Dr. E. M. Magruder of Charlotteville, Va., read a most interesting paper, replete with many neglected historical facts. The toasts of the occasion by Dr. Hendon, Mr. Brower and Mrs. L. Van Varseveld McMechan were thoroughly enjoyed, as were the musical numbers rendered by Mr. Emms, and Miss Browne and the quartette composed of Mr. and Mrs. Douglas Webb, Miss Ross and Dr. North.

Dr. Sherrill, President of the Jefferson County Medical Society, wished the banquetters "good-night!" Louisville outdid itself in hospitality and the Convention League and its representative, Mr. Goode, did everything possible to make the accommodations and entertainment for the meeting a success.

SOME OBSERVATIONS ON THE ANESTHETIC AND INHIBITORY PROPERTIES OF THE MAGNESIUM SALTS.*

S. J. MELTZER, M.D.,

New York City.

I greatly appreciate the honor of your invitation to address the American Association of Anesthetists, and yet I would hesitate to avail myself of this opportunity of making Some Observations on the Anesthetic and Inhibitory Properties of the Magnesium Salts, were it not for the fact that some of our experimental researches have been put to the crucial test of clinical results with a very satisfactory measure of success.

For a number of years I have been deeply interested in the theoretical phases of the inhibitory properties of the magnesium salts. With your permission I will deal briefly with the phenomena of inhibition, as I understand them, and then proceed to discuss the inhibitory actions of the magnesium salts, which we have observed in our experimental studies at the Rockefeller Institute, and which led up to the use of magnesium sulphate in tetanus, then for anesthesia in animal research, and more recently for anesthesia in operative procedures on the human subject.

When the Weber brothers found that stimulation of the peripheral end of the vagus nerve stopped the heart in diastole by inhibiting its contractions, the phenomenon of inhibition was discovered. In the past seventy years many other physiologic processes have been discovered, which have had to be interpreted as inhibitory phenomena. You are all familiar with the fact that when accelerator and inhibitory nerve fibres are simultaneously stimulated that the inhibition may prevail during this period of stimulation or else the augmentors may predominate *during* stimulation and the inhibitors produce the longer *after-effects.* This antagonism applies not only to the motor sphere, but exists also in the functions of secretion and sensation, and furthermore, is applicable to functions in which the augmenting and inhibitory processes are not represented by well defined nerves or other morphological units.

Now by an analysis of numerous living phenomena I came to the conclusion that *all living functions are continually controlled by two opposing forces: augmentation or action on the one hand, and inhibition on the other.* The state of every function at every moment depends on the relative predominance of each of these opposing forces. Taking motion as an instance the maximum effect of the action factor in the living body is *tetanus* and the maximum inhibition is complete relaxation or *anesthesia.* The various degrees of tonus represent an intermediary state in which one or the other of the opposing forces predominates.

Under the influence of the conception that inhibition is an important factor in the functions of the living body, the question arose in my mind whether or not a definite relation existed between the magnesium ion in the body and its various states of inhibition or depression. This conception was emphasized by the experimental fact that while the effects of nearly every kind of salt consisted in the causation of more or less intense and convulsive attacks, that after an intracerebral injection of a few drops of magnesium sulphate solution the animal turned on one side and remained for hours in a stuporous condition. A review of the literature revealed that the action of the magnesium salts had been only superficially studied, as had also the phenomena of inhibition. Consequently, during the last twelve years, with Dr. John Auer and other associates, I have investigated the various actions of the magnesium salts on the animal body in the department of physiology and pharmacology of the Rockefeller Institute. After long experience I may say today that the *dominant* action of the magnesium salts on the living body, no matter how administered, consists in *depression* or *inhibition.*

When, as it was found originally by Dr. Auer and myself, after the administration of a very small amount of ether, insufficient to cause anesthesia, an inefficient amount of magnesium sulphate is injected intramuscularly, a profound anesthesia follows, which can be maintained for hours. Consciousness is the first thing which is completely abolished. The unconsciousness is, as a rule, accompanied by great muscular relaxation, while all the reflexes may still remain nearly unaffected. With a larger dose of magnesium the reflexes too begin to disappear, and with a still further increase of the magnesium dose the motor nerve endings become paralyzed—a curare-like action—which is accompanied by a simultaneous profound central action. These facts were especially confirmed in a number of operations performed by Drs. Peck and Elsberg on human beings.

Chemically calcium and magnesium are closely related substances. Biologically, however, they are strikingly antagonistic to each other. Auer and I found that an animal which had been completely paralyzed by magnesium salts, could be restored within a fraction of a minute by an intravenous injection of a calcium salt, provided the ani-

*Abstract of an Extemporaneous Address delivered during the Fourth Annual Meeting of the American Association of Anesthetists, Detroit, June 12, 1916.

mal had only been exposed to the effect of magnesium for a comparatively short time. When the animal is saturated with magnesium for a longer period the antagonistic action of calcium is less evident and is even not without some danger.

My theoretical explanation of these phenomena is that the magnesium solution in the lymph bathing the *synaptic membrane* inhibits the passage of nervous afferent impulses from one neuron to the other, especially of such impulses for which there is less resistance to the entrance of magnesium solutions that the more solid membrane of the motor nerves and the muscle. Calcium when present in the lymph in a larger quantity than normal enters readily into the synaptic membrane and displaces or neutralizes there the obstructing or the inhibiting magnesium. When, however, the magnesium has permeated the nerve cell, the calcium is incapable of neutralizing its inhibitory action.

In view of our extended laboratory researches and the clinical use of magnesium in the treatment of tetanus in the war hospitals of Europe, I might summarize that phase of the subject as follows:

In each and every case of tetanus 1.2 cc. of a 25 per cent. solution of magnesium sulphate should be given by subcutaneous injection three to four times a day throughout the course of the disease. When the disease is complicated by severe tetanic attacks, 1 cc. of a 25 per cent. solution for every 20 pounds of body weight, in adults, should be given by the intraspinal method. When the disease is attended by immediately dangerous tetanic complications, from 2 to 3 cc. per minute of a 6 per cent. solution of magnesium sulphate should be given by intravenous injection until the dangerous symptoms subside or the respiration becomes shallow or too slow. When respiration becomes embarrassed a small amount of calcium chlorid, 2.5 per cent., should be slowly injected through the venous canula, used for the infusion of the magnesium, until respiration shows definite improvement, which may occur in 30 seconds; the calcium injection should then be immediately discontinued, otherwise all previous tetanic manifestations may make their reappearance. Also an intrapharyngeal insufflation apparatus should be at hand for use whenever the integrity of respiration becomes endangered.

With regard to the use of magnesium for anesthesia, let me say that while it has proven itself satisfactory in the limited clinical trials of Drs. Peck and Elsberg, I would deplore any effort on your part to put the method into routine practice. It is still in the experimental stage and must be used with the utmost caution. It is certainly interesting, however, that a solution of a constituent of the body introduced intravenously is capable not only of removing all sensation, but also of producing absolute unconsciousness. One of the patients operated on by Dr. Peck for a double herniotomy, remarked to me after his return to bed: "Was I operated on? I heard you talking and felt you must be doing something; but I could not move nor did I feel any pain. I did not think you had operated."

Dr. Peck did not attempt a surgical procedure under magnesium anesthesia on a human being, until after he and his anesthetist had painstakingly prepared themselves for the ordeal by animal experimentation. It may be said in passing that the human being is much more sensitive to the effects of the inhibitory properties of magnesium than the dog, although in the antidotal use of calcium chlorid we have a rapid and efficient remedy for counteracting any untoward effects of magnesium anesthesia.

One of the advantages of magnesium anesthesia is that recovery is rapid and without complications. It produces a hyperglykemia not a hyperglycosuria.

There is no fool like an old fool, and yet old and foolish as I am, I cherish the hope that our experiments will eventuate in establishing in magnesium anesthesia a safe, practical and efficient routine method of surgical narcosis. (Applause)

ABSTRACT OF DISCUSSION.

DR. W. D. GATCH, Indianapolis, Ind.: I am sure that I voice the extreme satisfaction of the entire Association in expressing our thanks to Dr. Meltzer for his interesting address. I recall an interesting case of magnesium poisoning during my interneship. The case was brought into the hospital in a condition of coma and the diagnosis made through the finding of crystals of magnesium sulphate in the urine. It developed that the patient had been in the habit of taking two or three ounces of magnesium sulphate every day over a long period of time. I have seen other patients whom I thought suffered from chronic magnesium sulphate poisoning from excessive, daily use of Epsom salts. I also recall a severe case of tetanus, a patient of Dr. R. Miller of Pittsburgh, who was saved by intraspinous injections of magnesium sulphate. This patient's convulsions were so severe that with his head on one chair and his feet on another, his body, otherwise unsupported, remained as rigid as an iron bar. In this case one injection of 10 cc. of a 25 per cent. solution of magnesium sulphate intraspinously, would produce complete paralysis of the body up to the diaphragm for from nine to ten hours. After being kept under the influence of the magnesium for six days the patient fully recovered. The method is a dangerous one to use routinely unless one is familiar with the action of magnesium and also the antidotal use of calcium chlorid.

In closing I believe Dr. Meltzer could add a few interesting remarks about the local analgesic action of magnesium sulphate.

DR. J. T. GWATHMEY, New York City: I should like to know the percentage, strength and amount of the solution that Dr. Meltzer used for intravenous injections.

DR. S. J. MELTZER (closing): Regarding the local analgesic action of magnesium, I would state that we succeeded in producing analgesia in the nerves of the rabbit, experimentally, but failed in our experiments on frogs. Personally, however, I have used 25 per cent. and even stronger solution locally in first and second degree burns, over painful areas and in the treatment of erysipelas. Hare quotes an instance of local anesthesia of the entire foot from an application of a 25 per cent. solution of magnesium sulphate.

Answering Dr. Gwathmey's question, I would state that in tetanic seizures, magnesium sulphate solutions may be used intravenously in 6 per cent. solution from 2 to 3 cc. per minute, or in a 3 per cent. solution from 5 to 6 cc. per minute, but the infusion should be stopped at once if respiration becomes slow or shallow. Ten per cent. solutions may cause paralysis of the heart lasting from 2 to 3 minutes and for this complication there is no antidote. For anesthesia, however, the 6 per cent. solution is not always efficient, hence I would reiterate my caution about the use of the method until definite data have been accumulated for your guidance. The sphere of useful and the margin of safety of magnesium sulphate anesthesia may prove to be so narrow as to preclude its routine use.

It was formerly my impression that coma could not result from the ingestion of magnesium sulphate by the mouth, because of its rapid elimination by the kidneys after absorption. About two years ago, however, we found experimentally that we could readily kill animals by injecting magnesium into any part of the intestinal canal. The magnesium sulphate is chemically altered in the stomach as a rule, but if it passes into the intestines unchanged it may produce harmful results.

In view of the experimental introduction of various substances into the duodenum, it may be of interest to inform you that magnesium sulphate so introduced will relax the spincter of the common duct. This can be accomplished by the administration of magnesium through the duodenal tube and it introduces the question of the advisability of such a procedure in the presence of jaundice with pain, due to colic of the intestines from the antagonistic action of the fibres of the gall-bladder in attempting to drive out the bile and in the contraction of the common duct spincter to prevent its escape.

Newer Apparatus

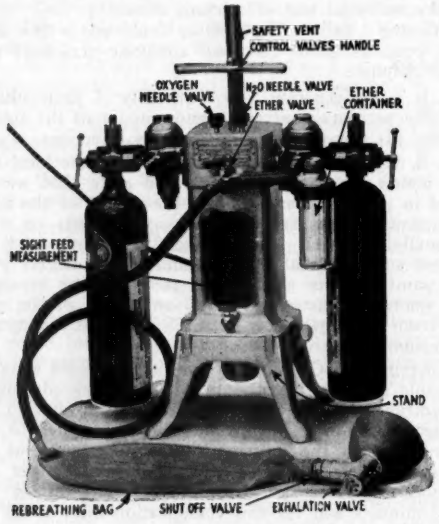
Editor's Note: From time to time this Department will publish Illustrations and Technical Details of the Newer Apparatus for Anesthesia and Analgesia.

GAS-OXYGEN ANALGESIA IN EYE, EAR, NOSE AND THROAT SURGERY.*

WILL WALTER, M.D.,
Chicago, Ill.

This paper deals with the means and technic employed in the production of *analgesia* for cases in office and bedside practice, for which we ourselves should provide painless surgery, not only to save time, effort and expense, but also to spare patients the distress incident to minor surgery and to eliminate fear and shock.

Analgesia differs from anesthesia in that patients remain quite amenable to suggestion, though they may have



all their senses obtunded to the verge of unconsciousness. Dilution of gas with oxygen, varying from 10 to 50 per cent., governed by the varying susceptibility of patients, will provide any needed degree of analgesia. This ratio of gas to oxygen is reduced when preliminary medication with morphin-scopolamin is used to relax the mentally fearful patient.

In dentistry it is possible to employ any ratio of oxygen to nitrous oxid through the medium of a tight fitting nose mask and to continue its administration for analgesia indefinitely, because the patient is able to obstruct his mouth breathing by means of the tongue without interference with operation upon the teeth. The application here simulates general gas-oxygen analgesia and is the same as for all operations with which we are concerned, with the exception of work beyond the wall voluntarily brought about by the apposition of the soft palate, the tongue and the anterior pillars. Therefore our problems are the same as other problems with reference to this type of anesthesia so long as air may be excluded from respiration. But for surgery of regions behind this wall we are obliged to produce an anesthesia and to work rapidly as soon as this wall is opened and air of necessity inhaled.

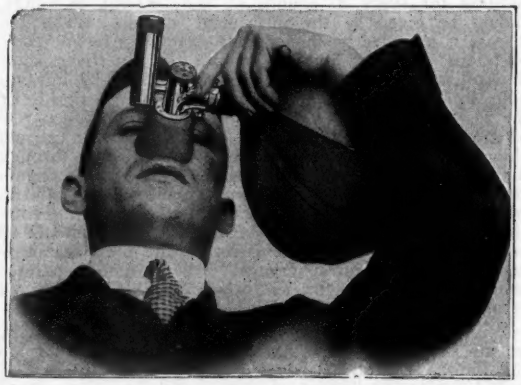
As to how we endeavor to meet this will be seen later, for while we may not produce anesthesia with the mouth open we may produce a degree of analgesia if we throw into the mouth a stream of pure nitrous oxid sufficient to minimize the amount of air in the mixture, producing a fairly good proportion for the production of analgesia.

Successful administration of analgesia requires perfectly adaptable nasal or oral inhalers; pressure-reducing valves; percentage control of the gas-oxygen mixtures; moistening and washing of the gases and warming; preferably a sight-feed for guaging the mixture of the gases; rebreathing; concomitant etherization, and finally cooperation on the part of the patient.

Analgesia is available for the following operations:

In Ophthalmology—Opening of lid abscesses, operations upon cysts, styes and small tumors. Electrolysis, painful epilations, cauterization of ulcers. Removal of stitches, removal of deep foreign bodies. Passing of lacrymal probes, slitting of canthi, expression of trachoma bodies. Repairs of traumatisms. Sewing up of lacerations, and painful applications and examinations generally. It is available for most operations upon the lid and I once used it for Ziegler's cautery operation for entropion.

In Rhinology—Incision of furuncules. Opening and curetting of abscesses and of ethmoidal cells and any painful intra-nasal work; puncture and drainage of antra, removal of polyps, post-turbinal hypertrophies, cauterizations, removal of stitches from frontal sinus operations and the passing of probes in these cases. All these opera-



tions are done using the mouthpiece and inhaler. Adenoidectomy and tonsillectomy have frequently been done in the office, employing this method. Peritonsillar abscesses are easily cared for and the patients' control over their expectoration is of great value.

In Otology—Incision of furuncules, painful probings, removal of stitches, removal of polyps, curettage of granulations, all painful dressings and applications and examinations. It is particularly valuable in paracentesis and for ossiculectomies. In first dressings after mastoid it is wonderfully comforting.

TECHNIC OF ADMINISTRATION.

The tanks are attached, after which warm water is poured in up to the marked water line. The hydrostatic safety valve is always open at the top and if water is poured through this opening it first fills the safety valve and then overflows into the mixing chamber.

For operations of twenty minutes' duration or less we depend upon the water for the heating, but for longer cases we attach the plug of the heating coil to a convenient socket.

Both needle valves are now closed and the outflow valves on the tanks are fully opened, also the one hand control valve. The pressure of gases is now at the needle valves and ready for the determination of its flow by opening these valves. The nitrous oxid needle valve is first opened to the required flow and the level is noted, after which the oxygen needle valve is set at the desired percentage. The control valve is now closed and we are ready.

* Read before the American Academy of Ophthalmology and Oto-Laryngology, Chicago, October 5, 1915.

The proper mask is applied to the patient, mouth piece if for nose operation, nose mask if for mouth operation and the whole face mask if for general work.

The control valve is now opened and the breathing bag allowed to fill with the mixture of gases. This is accomplished by closing the outlet valve of the mask. The outlet valve is then opened, allowing to and fro breathing, and the patient is directed to inhale and is allowed to until he fails to answer questions—he is in the analgesic state. If something painful is to be done he is told to breathe more deeply and will pass into anesthesia.

For rebreathing the control valve is turned off and the outlet valve closed; or both the control valves may be opened to give partial rebreathing and partial to and fro breathing, all according to the needs to be met.

When it is desired to add ether, the ether cylinder is slipped on and ether dropped into the cup as desired. The amounts of ether and gases and the degree of rebreathing are always under control of the anesthetist and without removal of the mask.

This is the technic for all analgesia where exclusion of

air is possible, full masks being employed. For operations upon the eye or nose the mouth piece is employed.

This carries only a mixing chamber with exhalation valve and bag attachment. The mouth piece is held firmly by the teeth, the lips closed over it, the apparatus being off side and out of the way. Nasal breathing being excluded by plugging we have again the exclusion of air; a dentist's rubber dam applied accomplishes this for deeper degrees of analgesia or for anesthesia when control is lost.

For operations upon tonsil or post-tonsilear areas it becomes necessary to switch from the rebreathing mask to the free flow of gas.

The technic is as follows: the *nose piece is employed* until anesthesia is well established. The apparatus being provided with direct flow under pressure from twelve pounds to a few ounces as desired, directly from the reducing valves, the gas tube is introduced into the mouth directly or through a tube carrying gag or by what is very good, a Foregger mouth piece. The direct flow is instituted, and sufficient gas is forced into the now open mouth to maintain analgesia.

The patient is able to expectorate blood if the tubes are employed rather than the gag, but it is necessary to start with gag in place since many patients shut the mouth tightly when passing into anesthesia and time is lost in forcing it open. It is difficult to voluntarily expel blood from the mouth with a gag *in situ*. Analgesia allows the patient to voluntarily expectorate and they will do so when bidden.

When employing analgesia we usually take one tonsil, allowing time for stemming hemorrhage on that side before doing the other, but it is sometimes easier to free both pillars under local anesthesia and then while in the analgesic state to do both excisions before they recover.

Our most successful routine in tonsillectomy is: *first*, preliminary hypodermic of morphine and atropin one hour before operation, dose according to age; surface anesthesia with cocaine and adrenalin; three injections of 2 per cent. novocaine and adrenalin on each side, one under the mucosa of the anterior and posterior pillars, the third in the capsule of the tonsil, the needle being introduced deeply above the tonsil. The patient is in the upright position and the tonsil is freed by sharp or blunt dissection as needed, the tonsil being held on the stretch. If the patient is nervous or hyperesthetic or is complaining we then do the same to the opposite tonsil, after which analgesia is given and both tonsils removed by snare. If the patient is not complaining gas is not used, operation being concluded upon the first side before the second is dissected. If the Sluder is done, both tonsils are taken with one analgesia if possible; more often one is taken out at a time, the second after bleeding in the first is checked.

For endolaryngeal work the continuous flow may be employed, and as it is most important here to have warmed, washed and humid gases, and low pressure, we may temporarily stop off the safety valve and thus forcibly expel the gases from the bag in any quantity or by pass flow of the gas directly.

For adenoidectomy a simple administration of gas-oxygen is all sufficient, as the operation may be done before the patient comes out of the analgesia.

The thought is prevalent that little children cannot take gas-oxygen because they have not sufficient respiratory power, but with this lower pressure apparatus and its safety attachment no trouble has been experienced. Often the child will struggle, but he will not afterwards remember that he has been subjected to traumatism.

Recovery from analgesia is a matter of two or three minutes and no untoward effects have been observed.

122 South Michigan Avenue.

Index and Abstracts

A Résumé of the International Current Literature of Anesthesia and Analgesia

EDITOR'S NOTE: Authors of pertinent articles, who desire to have them indexed and abstracted, are cordially invited to send copies of the journals containing their contributions, direct to the editor, immediately on publication. Also the receipt of reprints for filing and reference will be duly appreciated.

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